と，老人クラブや趣味の会などグループ活動の場が運動の実施を促進させる有効な手段として活用できること，さらに社会活動そのものを促すことも運動習慣の定着に有効であることが考えられた．

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ORIGINAL ARTICLE

The nutritional status of frail elderly with care needs according to the mini-nutritional assessment

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KEYWORDS
Elderly;
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Summary
Background and aims: Although malnutrition is common in the geriatric population, the relationship between frail elderly with various care needs and nutritional status remains unknown. The purpose of this study was to analyze the association between subjects with higher care needs and poorer nutritional status in the Japanese community-dwelling frail elderly.
Methods: A total of 281 community-dwelling elderly subjects from day-care centers (81.9±7.2 yr of age mean±SD; 72 men and 209 women) who were eligible for Long-Term Care Insurance were enrolled in this study to evaluate their nutritional status using the mini-nutritional assessment. The levels of care needs of participants were classified into six levels according to the Long-Term Care Insurance program.
Results: According to the mini-nutritional assessment classification, 39.9%, 51.2%, and 8.9% of the participants were assessed as well-nourished, at-risk of malnutrition, and malnourished, respectively. There were significant differences among the six groups with regard to the nutritional status; subjects with higher care needs were associated with poorer nutritional status. In the higher care needs group, more than half of the subjects did not know their weight change during 3-month intervals.
Conclusions: The population of elderly with higher care needs in the community is associated with a higher prevalence of malnutrition.

Introduction

Good nutritional status is crucial for "a healthy life" and malnutrition is related to an increased incidence of morbidity and mortality in the elderly.[1] The

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relationship between poor nutritional status and impaired immune functions, pressure sores, and impaired muscle function is well established.[2,3] For these reasons, it has been proposed that a nutritional status risk assessment be incorporated as an essential component of the comprehensive geriatric evaluation, which should be performed in all elderly people. Clinical assessment tools for determining the nutritional status of the elderly have recently been developed, but are not yet fully used.[4–6] Among those is the mini-nutritional assessment (MNA), which is a simple clinical scale for the evaluation of the nutritional status of frail elderly subjects. The MNA has been validated in elderly people by comparing its results with those of clinical assessments performed by expert geriatric nutritionists.[7,8] It is a cheap and easy way of screening elderly individuals to detect those who are at-risk of developing complications caused by malnutrition. Recently the researchers of the present study evaluated the MNA test as a screening tool for malnutrition in the Japanese elderly population from which it was concluded that the MNA full test is a useful screening tool for identifying Japanese elderly with malnutrition or a risk of malnutrition.[9]

On 1 April 2000, Japan started a public, mandatory Long-Term Care Insurance (LTCI) program for elderly people who need assistance.[10] The program covers nearly the full cost of institutional or community-based care (formal services only), depending on the level of care needed. The instrument used to classify the level of care needs was developed based on a large-scale time study of professional caregivers in LTC institutions.[11] The data on approximately 10 million minutes of care provided by 2376 professionals to 3800 seniors were coded into 328 predetermined care activities, and the amount of time the caregiver spent on each senior was calculated for each activity. These data were used to develop tree regression models. Everyone of age 65 years and older, plus anyone of age 40–64 years with an aging-related disability (i.e., Alzheimer's disease or stroke), is eligible for LTCI. After individuals (or their families) apply to the municipal government for assistance, an on-site assessment is conducted of each applicant's physical and mental status. Eligibility is strictly a matter of age, physical and mental status, and whether or not the individual has undergone medical procedures; income and family situation do not matter. The results are entered into a computer and the applicant's standardized scores are calculated for seven dimensions including physical (e.g. washing face, putting on and taking off a jacket, taking medication, financial management, utilization of telephone) and mental status (e.g. understanding daily schedule, short memory, remember own name), and the estimated time required for eight categories of care (grooming/bathing, eating, using the toilet, transferring, assistance with instrumental activities of daily living, behavioral problems, rehabilitation, and medical services). A care-needs level based on the total estimated care minutes is then assigned to each individual. The assessment is analyzed so that each applicant can be classified into one of the six levels (or rejected), according to the level of care needed. An expert committee reviews the classification by taking into account the descriptive statements plus a report from the applicant's doctor. If dissatisfied with the decision, applicants may appeal to an agency at the prefecture level and ultimately to the courts. The lowest level, called the "assistance required" level, is assigned if the total amount of time to care is less than 32 min per day at home (Need support). The other five levels are called "care required" levels, ranging from the lowest requirement of care (care level 1) to the most severe (care level 5) need of care. Level 5 is assigned if the total amount of time to care is more than 110 min per day at home. Eligibility is to be re-evaluated every 6 months.[10,11]

Because data on the nutritional status of frail elderly individuals who are community-dwelling and eligible for LTCI remains scant, the purpose of this study was to obtain information about the nutritional status of individuals who are eligible for LTCI by using the MNA, and to analyze whether or not the subjects with a higher level of care needs are associated with poorer nutritional status.

Materials and methods

Subjects

The subjects of this study were recruited from four Domiciliary Care Centers in Aichi, Gifu, and Mie Prefecture, Japan, in February 2004. The subjects were frail individuals who were community-dwelling and utilized the center for training with a physical therapist and other services. These services were covered by LTCI, and all of the subjects had registered with the Domiciliary Care Center individually.

Using the MNA, the nutritional status of 304 subjects who had no difficulty in communicating with the researchers and utilized a care center during examination period was analyzed. The analysis included 281 (72 men and 209 women) subjects who agreed to participate in this study, had a complete MNA, and were 65 years old or older.

Informed written consent was obtained from each subject, or from a family member. The study protocol was approved by the Human Ethics Review Committee of Nagoya University Graduate School of Medicine.

Nutritional assessment

The MNA is composed of 18 items, including anthropometric measurements [weight, height, mid-arm circumference (MAC), calf circumference (CC), and weight loss during the past 3 months], a global assessment (six questions related to life-style, medication, and mobility), a dietary assessment (eight questions related to number of meals, food and fluid intake, and autonomy of feeding), and a subjective assessment (self-perception of health and nutrition). The maximum score is 30 points, with the risk of malnutrition increasing with lower scores.[7]

The MNA score was used to classify subjects as well-nourished (a score of 24–30), at-risk for malnutrition (a score of 17–23.5), or malnourished (a score of <17) according to the original cut-off point of the MNA full test.[12] Body mass index (BMI) is defined as weight in kilograms, divided by height squared. The MNA was administered by dietitians, except for the mental state and medication MNA questionnaire which was obtained from nursing staff members or medical records.

Statistical analysis

All analyses were conducted using SPSS statistical software (Version 11.0J for Windows).

A probability value of 0.05 or less was considered significant.

Partial correlation coefficients were used to measure the association between variables. Differences among the six care levels were determined by analysis of variance with a Bonferroni correction or the Kruskal–Wallis test, depending on the distribution of the analyzed variable. The χ^2-test was used to test categorical variables. To examine the relationship between the care levels of subjects and body weight change, body weight change in the past 3 months was classified into four groups (a) weight loss greater than 3 kg, (b) does not know the weight change, (c) weight loss between 1 and 3 kg, and (d) no weight loss. This classification is included in one of 18 items of the MNA.

Results

The subjects' characteristics are presented in Table 1. The average age of the subjects was 81.9±7.2 (SD range: 65–99 years). BMI averaged 22.1±3.8 (SD) and ranged from 12.8 to 34.6. MNA scores averaged 22.5±3.8 (SD) and ranged from a minimum of 10.0 to a maximum of 30.0, with a median of 23.0. The most common eligibility status observed in the participants was care level 1.

Table 2 shows the mean results of variables, which are expressed according to the care levels. There were significant differences among the six care levels with regard to BMI ($P=0.03$), CC ($P<0.001$), and MNA scores ($P<0.001$), but not MAC. Subjects who were classified as care level 5 had significant lower BMI, CC, and MNA than (as a result of Bonferroni correction). A significant correlation was found between the care levels and anthropometric measurements after adjustments for age and gender (BMI: $r=-0.173$, $P=0.004$, CC: $r=-0.329$, $P<0.001$). There was a significant correlation between MNA scores and the care level of LTCI ($r=-0.416$, $P<0.001$),

Table 1 Subject characteristics.

Number of subjectis (men/women)	281 (72/209)
Age (yr), mean±SD	81.9±7.2
Body mass index (kg/m^2), mean±SD	22.1±3.8
Mid-arm circumference (cm), mean±SD	23.9±3.8
Calf circumference (cm), mean±SD	30.7±3.5
MNA score, mean±SD	22.5±3.8
Number of subjects at each LTCI care needs levels, *n* (% of total)	
Need support (≥25, <32 estimated total care minutes per day)	27 (9.6)
Level 1 (≥32, <50 estimated total care minutes per day)	130 (40.3)
Level 2 (≥50, <70 estimated total care minutes per day)	57 (20.3)
Level 3 (≥70, <90 estimated total care minutes per day)	28 (10.0)
Level 4 (≥90, <110 estimated total care minutes per day)	27 (6.6)
Level 5 (≥110 estimated total care minutes per day)	12 (4.3)

Table 2 LTCI care needs levels and gender, age, anthropometric measurements, MNA scores.

	Need support ($n = 27$)	Level 1 ($n = 130$)	Level 2 ($n = 57$)	Level 3 ($n = 28$)	Level 4 ($n = 27$)	Level 5 ($n = 12$)	P
Men/women (n)	4/23	33/97	12/45	8/20	10/17	5/7	0.318*
Age (yr), mean±SD	84.7±5.0	82.0±7.1	81.9±7.9	81.4±7.0	79.7±7.9	80.7±7.0	0.215†
BMI (kg/m^2), mean±SD	21.6±3.7	22.4±3.6	22.9±4.0	22.3±4.0	20.3±3.7	19.5±3.3	0.003‡
Mid-arm circumference (cm), mean±SD	23.9±2.8	23.9±3.3	23.5±4.0	24.3±3.1	23.5±3.4	22.2±2.1	0.155‡
Calf circumference (cm), mean±SD	31.1±2.5	31.4±3.5	30.4±3.4	30.9±3.4	29.0±2.8	26.5±2.8	<0.001‡
MNA scores, mean ±SD	24.2±3.3	23.1±3.1	22.8±3.5	22.7±3.5	19.8±3.5	15.6±3.7	<0.001§

Bonferroni correction.BMI: Level 1 vs Level 4 ($P = 0.046$); Level 2 vs Level 4 ($P = 0.022$); Level 2 vs Level 5 ($P = 0.04$)
Calf circumference: Need support vs Level 4 ($P = 0.019$), Level 5 ($P<0.001$); Level 1 vs Level 4 ($P = 0.001$), Level 5 ($P<0.001$); Level 2 vs Level 5 ($P = 0.001$); Level 3 vs Level 5 ($P = 0.001$).
MNA scores: Needsupport vs Level 4 or Level 5 ($P<0.001$); Level 1 vs Level 4 or Level 5 ($P<0.001$); Level 2 vs Level 4 or Level 5 ($P<0.001$); Level 3 vs Level 5 ($P<0.001$); Level 4 vs Level 5 ($P = 0.003$).
*χ^2-test.
†Analysis of variance.
‡Means were adjusted for gender and age using analysis of covariance.
§Kruskal–Wallis test.

Table 3 LTCI care needs levels and mini-nutritional assessment.

	Need support ($n = 27$) n (%)	Level 1 ($n = 130$) n (%)	Level 2 ($n = 57$) n (%)	Level 3 ($n = 28$) n (%)	Level 4 ($n = 27$) n (%)	Level 5 ($n = 12$) n (%)	Total ($n = 281$) n (%)	P
								<0.001*
Malnourished (<17points)	1 (3.7)	5 (3.8)	4 (7.0)	1 (3.6)	6 (22.2)	8 (66.7)	25 (8.9)	
At risk for malnutrition (17–23.5points)	9 (33.3)	68 (52.3)	30 (52.6)	16 (57.1)	17 (63.0)	4 (33.3)	144 (51.2)	
Well nourished (⩾24points)	17 (63.0)	57 (43.8)	23 (40.4)	11 (39.3)	4 (14.8)	0	112 (39.9)	

*χ^2-test.

which suggests that subjects with a higher care requirement are associated with a higher prevalence of malnutrition.

Table 3 shows the distribution of the nutritional status according to the care levels of the participants. Seventeen (63.0%) subjects who were classified at 'Need support' and 57 (43.8%) subjects at level 1 were identified as well-nourished. Sixty-eight (52.3%) subjects who were classified at level 1 and 30 (52.6%) subjects at level 2 were identified as at-risk for malnutrition. Six (22.2%) subjects who were classified at level 4 and 8 (66.7%) subjects at level 5 were identified as malnourished. There were significant differences among the three groups with regard to level of LTCI ($P<0.001$).

Table 4 shows the relationship between weight change categories and care level of LTCI. Nineteen (70.4%) subjects who were classified at 'Need support' and 94 (72.3%) subjects who were classified at level 1 had not lost any weight during the previous 3 months, suggesting that subjects with low care requirements are associated with a higher prevalence of the absence of weight loss. Seven (58.3%) subjects who were classified at level 5 did not know that they had undergone weight loss during the previous 3 months.

Table 4 LTCI care needs levels and weight loss during 3 months.

	Need support ($n = 27$) n (%)	Level 1 ($n = 130$) n (%)	Level 2 ($n = 57$) n (%)	Level 3 ($n = 28$) n (%)	Level 4 ($n = 27$) n (%)	Level 5 ($n = 12$) n (%)	Total ($n = 281$) n (%)	P
								0.002*
Greater than 3 kg	1 (3.7)	3 (2.3)	4 (7.0)	3 (10.7)	2 (7.4)	1 (8.3)	14 (5.0)	
Does not know	3 (11.1)	12 (9.2)	7 (12.3)	4 (14.3)	7 (25.9)	7 (58.3)	40 (14.2)	
Between 1 and 3 kg	4 (14.8)	21 (16.2)	8 (14.0)	2 (7.1)	6 (22.2)	0 (0.0)	41 (15.6)	
No weight loss	19 (70.4)	94 (72.3)	38 (66.7)	19 (67.9)	12 (44.4)	4 (33.3)	186 (66.2)	

*χ^2-test.

Discussion

In the present study, 51.2% of subjects who were community-dwelling and eligible for LTCI were at-risk of malnutrition, and 8.9% were malnourished, according to the MNA classification. There were few subjects who were identified as well-nourished. In agreement with others' research and a previous study conducted by the researchers of the present study, the care level of LTCI was well correlated with anthropometric variables including BMI, and CC. It has been reported that in a study of 250 domiciliary care clients in Australia (average age—79.5 years, age range—67–99 years), 38.4% of the subjects were at-risk of malnutrition, and 4.8% were malnourished.[13] Soini et al.[14] reported in Finland, as classified by the MNA, 48% and 3% of the 178 home-care elderly (average age—83.5 years age range—75–94 years) were evaluated as at-risk of malnutrition and malnourished respectively. The higher prevalence of being at-risk of malnutrition and being malnourished among participants in this study may be due to the higher frailty of its subjects.

Although it has been reported that disability in activities of daily living (ADL) is associated with poor nutritional status,[15] other studies have shown no such association. In fact, it has been demonstrated that there is no relation between ADL dependency and MNA scores.[16] It should be noted that the care level of LTCI does not reflect only the ADL dependency of the clients, since the six levels of LTCI are dependent upon the total care needs. These needs are reflected not only by physical and mental status, but also by the need for medical assistance. This study demonstrated that subjects with higher care needs (i.e., higher eligible care level) are associated with poorer nutritional status, and the care level in the LTCI policy was classified based on the estimated amount of time the caregiver spent on each care recipient, suggesting that the total amount of time to care correlates with the nutritional status of frail elderly in the community. However, it should be noted that even at the lowest level, known as 'assistance required' (Need support), more than 30% of the subjects were diagnosed as at-risk of malnutrition and at care level 1, more than 52% of the subjects were thus diagnosed. The results indicate that the nutritional status starts to decline even before the need for care begins to develop. It was assumed in this study that the decline of nutritional status may contribute to the need for a greater level of care.

In elderly individuals the loss of body weight, apart from intentional weight reduction for overweight individuals, almost inevitably leads to poor health outcomes.[17–19] The decline in body weight after the age of 60 is disproportionately due to the loss of lean body tissue (i.e., sarcopenia); this has adverse effects on physical function.[20–23] Although body weight is easily measured, and a decline in body weight is a useful critical first sign of malnutrition, it is not unusual for body weight measurement to be neglected in day-care centers. Indeed, there was only one institution among the four domiciliary care centers studied that had been measuring body weight periodically before the present study. Furthermore, elderly individuals as well as their families are often not aware of their weight. These more frail elderly individuals are often the most difficult to weigh. In fact, we demonstrated that 58.3% of participants at care level 5 or 25.9% of participants at level 4 did not know their weight changes, indicating the negligence of weight measurement of subjects with higher levels of care needs. The lack of awareness among the staff members in day-care centers of the weight and changes in weight of their clients, as well as a similar lack of awareness among family members, indicates that little attention has been paid to the nutritional status of frail

elderly individuals in the community, despite the fact that many of them are already malnourished or at-risk of malnutrition. Early detection of malnutrition is important so that targeted nutritional intervention can be performed, and it should be a key component of the geriatric assessment. The regular measurement of the weight of clients is an indicator of the quality of care provided in day-care centers. Although weight loss is sometimes unavoidable in the frail elderly, early awareness of weight loss in day-care center clients will lead to an early and appropriate response to their weight loss by family or medical staff. In addition, this could lead to the thought that a part of the care requirement in the high levels of LTCI may be due to nutritional risk which might be treatable in order to reduce the care requirement at that level.

In conclusion, this study found that undernourishment was common in the community-dwelling elderly using day-care services covered by the LTCI program and the amount of time of care was associated with poorer nutritional status. Physicians, nurses, and dietitians who participate in providing health care to these frail elderly individuals should pay close attention to their nutritional status.

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Day Care Service Use Is Associated with Lower Mortality in Community-Dwelling Frail Older People

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OBJECTIVES: To clarify the association between day care service use and 21-month mortality in community-dwelling frail older people.

DESIGN: Prospective cohort study (the Nagoya Longitudinal Study for Frail Elderly).

SETTING: Community-based.

PARTICIPANTS: One thousand six hundred seventy-three community-dwelling older people (540 men, 1,133 women).

MEASUREMENTS: Data included the clients' demographic characteristics; depression as assessed using the short version of the Geriatric Depression Scale; a rating for basic activities of daily living (ADLs); comorbidity; number of prescribed medications and physician-diagnosed chronic diseases; use of home-care services, including day care, visiting nurse, and home-help services; and number of regular medical checkups. Survival analysis of 21-month mortality was conducted using Kaplan-Meier curves and multivariate Cox proportional hazards models.

RESULTS: Of the 1,673 participants, 726 were day care service users at baseline, and 268 (94 day care service users, 174 nonusers) died during the 21-month follow-up. Multivariate Cox regression models adjusting for potential confounders showed that day care service use was associated with reduction in mortality. Subgroup analysis demonstrated that day care service use was associated with less risk of mortality in subjects who were female; were in the youngest age group (65–74); had higher ADL scores, lower comorbidity, depression, no dementia; and used a visiting nurse service. Participants using day care service two and three times or more a week had 63% or 44% lower relative hazard ratios, respectively, than participants not using the service.

CONCLUSION: Among community-dwelling frail older people, day care service use two or more times per week was associated with 44% to 63% lower 21-month mortality. J Am Geriatr Soc 54:1364–1371, 2006.

Key words: day care service; mortality; elderly

In the last 2 decades, community care programs have been developed that aim at maintaining and improving the functional abilities and well-being of elderly people and reducing the use of institutional care services and mortality.[1,2] Such programs for elderly people are part of the national policy in several countries, including Japan, which introduced a universal-coverage long-term care insurance (LTCI) program in April 2000.[3,4] This program induced a radical change from traditional family-based care toward the socialization of elderly care and integration of medical care and welfare services.[3,4] Under the LTCI program, care levels are determined according to eligibility criteria. Eligibility status is classified into six levels ("needs support" and care levels 1–5) by estimation of care needs based on an assessment of the current physical and mental status of patients and their use of medical procedures.[5] The criteria for eligibility do not take into account the extent of informal family care available to clients. The maximum amount of reimbursement in the LTCI system is capped according to care level. Elderly beneficiaries pay a 10% copayment for services received. Care insurance covers two types of services: in-home (domiciliary) services (e.g., home help, bathing assistance, visiting rehabilitation, day care service, visiting nurse, assistive device leasing, short stays, in-home medical care, care management, and an allowance for the purchase of assistive devices and home renovation) and institutional services. One of the LTCI principles is to allow elderly persons and their family caregivers to choose the kind of services and service providers that they need.

Home care programs are often implemented with little evidence-based decision-making not only for clinicians but also policy for makers and caregivers. Increased demand for evidence-based decision-making is apparent not only in clinical settings but also in environments where related policies are written and enforced, thus creating a need for more research in this area. Of the services included in the LTCI program, there is little evidence of the effect of home-care services on the outcomes of the care recipients, including mortality. Day care service is provided in designated centers and is one of the major services used in LTCI programs. These are facility-based daytime programs of

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nursing care, rehabilitation therapies, supervision, and socialization that enable frail, older people who are in poor overall health with multiple comorbid illnesses and varying physical or mental impairment to remain in the community. An individual visits the facility one, two, or three or more times a week and then returns to his or her own home. Although a number of reports have evaluated the beneficial role of day care service use on the caregivers of older persons,[6,7] the effectiveness of day care service in terms of recipient outcomes of death, institutionalization, and disability has been questioned.[8,9]

The Nagoya Longitudinal Study of the Frail Elderly (NLS-FE) was designed to compare outcomes of different uses of care services provided by the LTCI program using a structured comparison of services and a comprehensive standardized assessment instrument.[10] The present study examined the effect of day care service on the mortality of community-dwelling older people eligible for the LTCI program.

METHODS

Subjects

The present study consisted of baseline data of the participants in the NLS-FE and mortality during the 21-month follow-up. Details of participants and the NLS-FE have been published elsewhere.[10] The study population consisted of 1,875 community-dwelling frail older people (632 men, 1,243 women, aged ≥65) who were eligible for LTCI, lived in Nagoya City, and were provided various home care services from the Nagoya City Health Care Service Foundation for Older People, which has 17 visiting nursing stations associated with care management centers. These NLS-FE participants, enrolled between December 1, 2003, and January 31, 2004, were scheduled to undergo comprehensive in-home assessments by trained nurses at baseline and 6, 12, 24, and 36 months. At 3-month intervals, data were collected about any events participants experienced, including admission to the hospital, nursing home admission, and mortality. Informed consent for participation, according to procedures approved by the institutional review board of Nagoya University Graduate School of Medicine, was obtained verbally from the patients or, for those with substantial cognitive impairment, from a surrogate (usually the closest relative or legal guardian) and from family member caregivers.

Data Collection

Trained nurses collected data at clients' homes using standardized interviews with patients or surrogates and caregivers and from care-management center records. Data included clients' demographic characteristics, depressive symptoms as assessed using the short version of the Geriatric Depression Scale (GDS-15)[11] and a rating for seven activities of daily living (ADLs) (feeding, bathing, grooming, dressing, using the toilet, walking, and transferring) using summary scores ranging from 0 (total disability) to 20 (no disability).[12] The interview with participants also included questions about the use of care, including day care service, visiting nurse, and home help service, as well as medical services.

Information obtained from care management center records included the following physician-diagnosed chronic conditions: ischemic heart disease, congestive heart failure, cerebrovascular disease (CVD), diabetes mellitus, dementia, cancer, hypertension, and other diseases included in the Charlson Comorbidity Index,[13] which represents the sum of a weighted index that takes into account the number and seriousness of preexisting comorbid conditions. In the present study, a physician diagnosed only a limited number of subjects with depression according to the care management center records. Therefore, participants were considered to be depressed if their GDS-15 score was 6 or higher. The data also included the number of prescribed medications.

For the analysis, 202 participants of the original 1,875 were excluded because of missing data for any type of service use or confounding/intermediary variables, leaving 1,673 in the analysis. Of these 1,673 participants, 391 could not complete the GDS-15 because of a severe cognitive or communication impairment.

Mortality was assessed over 21 months using event reports at 3-month intervals. Deaths were confirmed by visiting nurses or using care management center records. Survival time was defined as the number of months (3-month intervals) between the baseline interview and the event report of death or at 21 months from baseline, at which point the surviving participants were censored.

Statistical Analysis

The Student *t* test and chi-square test were used to compare differences between users and nonusers of day care service. The following baseline data of major clinical and sociodemographic data were used in a Cox proportional hazards model to identify independent predictors of 21-month mortality: age; sex; ADL status; living arrangement; number of prescribed medications; presence or absence of regular medical checkups; use or nonuse of home care services, including visiting nurse service, day care service, and home-help service; comorbidity status; and presence or absence of chronic disease, including ischemic heart disease, congestive heart failure, CVD, diabetes mellitus, dementia, cancer, and hypertension. The risk of a variable was expressed as a hazard ratio (HR) with a corresponding 95% confidence interval (CI). For the analysis, age was categorized into three groups (65–74, 75–84, and ≥85). The number of prescribed medications was categorized into three groups (≤2, 3–5, and ≥6). ADL score (range 0–20) and Charlson Comorbidity Index were categorized into three groups with approximately equal number of participants in each group (ADLs: high function, ≥18; mid function, 12–17, and low function, ≤11; Charlson Comorbidity Index: ≤1, 2–3, and ≥4). Additional analyses stratified by sex, age, ADL status, comorbid conditions, visiting nurse service use or nonuse, and presence or absence of dementia or depression were also performed using a consistent set of covariates to examine the data for possible interactions between these variables and 21-month mortality rate. For this analysis, age, ADLs, and Charlson Comorbidity Index were categorized into two groups (age: <80 and ≥80; ADL score: <15 and ≥15; Charlson Comorbidity Index: <2 and ≥2).

Survival curves describing mortality over 21 months after enrollment were conducted for each group (day care service use 1, 2, and ≥3 times/wk and nonusers) using the Kaplan-Meier method, adjusting for potential confounders. All analyses were performed using SPSS version 11.0 (SPSS Inc., Chicago, IL). $P \leq .05$ was considered significant.

RESULTS

At baseline, higher Charlson Comorbidity Index, prevalence rates of CVD, and dementia and lower GDS-15 score were observed for day care service users than for nonusers (Table 1). The rates of nursing service use and home help service use by day care service users were lower than those of nonusers, but there were no significant differences between users and nonusers in sex, age, ADLs, presence or absence of regular medical checkups, and use of three or more regular prescription medications.

Of the 1,673 participants, 268 died during the 21-month follow-up. A lower mortality rate at the 21-month follow-up was observed in day care service users than in nonusers (12.9% vs 18.4%, $P = .003$) (Table 1). One hundred sixty-eight of the 1,282 participants who were able to complete the GDS-15 and 100 of the 391 who were not died during the 21-month follow-up. A higher mortality rate was observed in the participants who could not complete GDS-15 test than in those who could (25.6% vs 13.1%, $P < .001$). The participants with an incomplete GDS-15 measurement were older (82.3 vs 80.2, $P < .001$) and had lower ADL scores (9.5 vs 14.4, $P < .001$), a higher Charlson Comorbidity Index (2.4 vs 1.8, $P < .001$), and a higher prevalence of dementia (65.0% vs 26.3%, $P < .001$) and history of CVD (43.0% vs 31.3%, $P < .001$) than those with a complete GDS-15.

Unadjusted univariate analysis suggested that 21-month mortality was associated with male sex (vs female, HR = 1.45, 95% CI = 1.14–1.86); the oldest age category (≥85, vs 65–74, HR = 1.97, 95% CI = 1.40–2.76); mid and low ADL function (vs high function, HR = 1.91, 95% CI = 1.33–2.74, and HR = 3.55, 95% CI = 2.53–4.98, respectively); two or more medical checkups per month (vs no checkup, HR = 1.62, 95% CI = 1.22–2.14); visiting nurse service use (vs nonuse, HR = 1.84, 95% CI = 1.44–2.35); Charlson Comorbidity Index of 2 to 3 and 4 or higher (vs <2, HR = 1.56, 95% CI = 1.18–2.06, and HR = 2.26, 95% CI = 1.65–3.10, respectively); and the presence of congestive heart failure (HR = 1.63, 95% CI = 1.15–2.33), depression (HR = 1.42, 95% CI = 1.03–1.95), dementia (HR = 1.94, 95% CI = 1.53–2.47), and cancer (HR = 2.36, 95% CI = 1.71–3.26) (Table 2). Lower mortality was associated with living alone (vs living with someone, HR = 0.43, 95% CI = 0.30–0.63), day care service use (vs nonuse, HR = 0.70, 95% CI = 0.55–0.90), three to five prescription medications (vs <3, HR = 0.65, 95% CI = 0.48–0.89), and the presence of hypertension (HR = 0.68, 95% CI = 0.50–0.92). Table 2 shows two different multivariate Cox regression models. Model 1 is based on the inclusion of all of the variables used in univariate analysis except for the presence or absence of depression and chronic diseases. Model 2 includes the presence or absence of depression and other chronic diseases instead of the Charlson Comorbidity Index. Comparable results were found from these two models. Male sex (vs female, Model 1, HR = 1.49, 95% CI = 1.15–1.92; Model 2, HR = 1.66, 95% CI = 1.21–2.30), oldest age (vs 65–74 years, Model 1,

Table 1. Characteristics of Day Care/Service Users and Nonusers at Baseline

Characteristic	Day Care/Service		*P*-value
	User (n = 726)	Nonuser (n = 947)	
Men/women, (% of men/total)	240/486 (32.1)	300/647 (31.7)	.55
Age, mean ± SD*	80.7 ± 7.7	80.7 ± 7.6	.90
Basic activities of daily living (range 0–20), mean ± SD*	13.3 ± 6.1	13.3 ± 6.5	.99
Charlson comorbidity index, mean ± SD*	2.1 ± 1.6	1.9 ± 1.6	.02
Geriatric Depression Scale-15, mean ± SD (range 0–15)*†	6.2 ± 3.6	6.7 ± 3.7	.01
Chronic diseases (%)			
Ischemic heart disease	12.3	12.6	.85
Congestive heart failure	8.7	8.6	.93
Cerebrovascular disease	38.7	30.4	<.001
Diabetes mellitus	11.4	12.2	.61
Dementia	42.3	30.0	<.001
Cancer	8.4	9.2	.58
Hypertension	26.3	22.7	.09
Visiting nurse service use (%)	40.1	54.0	<.001
Home help service use (%)	31.7	58.8	<.001
Regular medical checkups (%)	58.1	59.3	.62
≥3 regular prescription medications (%)	79.9	78.0	.36
Living alone (%)	21.6	24.4	.18
Death during 21-month follow-up, n (%)	94 (12.9)	174 (18.4)	.003

*Student *t* test, others were analyzed using chi-square test (user vs nonuser).
†Day care service user (n = 552), nonuser (n = 730).
SD = standard deviation.

Table 2. Cox Proportional Hazard Model to Identify Independent Predictors of 21-Month Mortality

Variable	Death/Total	Univariate (n = 1,673)	Multivariate Model 1 (n = 1,673)*	Multivariate Model 2 (n = 1,282)†
		Hazard Ratio (95% Confidence Interval)		
Men (vs women, death/total = 161/1,133)	107/540	1.45 (1.14–1.86)	1.49 (1.15–1.92)	1.66 (1.21–2.30)
Age (vs 65–74: death/total = 46/373)				
75–84	101/753	1.12 (0.79–1.59)	1.24 (0.87–1.76)	1.11 (0.72–1.71)
≥85	121/547	1.97 (1.40–2.76)	1.99 (1.40–2.83)	1.74 (1.11–2.74)
Basic ADLs (range 0–20) (vs high function (≥18): death/total = 45/555)				
Mid function (12–17)	87/602	1.91 (1.33–2.74)	1.52 (1.04–2.21)	1.30 (0.84–2.01)
Low function (≤11)	136/516	3.55 (2.53–4.98)	2.38 (1.61–3.51)	2.03 (1.27–3.25)
Living alone (vs with someone: death/total = 236/1,285)	32/388	0.43 (0.30–0.63)	0.70 (0.47–1.04)	0.84 (0.54–1.31)
Regular medical checkups per month (no regular checkup: death/total = 90/689)				
1	70/446	1.22 (0.89–1.67)	1.13 (0.82–1.56)	1.13 (0.75–1.69)
≥2	108/538	1.62 (1.22–2.14)	1.19 (0.88–1.61)	1.26 (0.87–1.84)
Formal care use (vs nonuse)				
Visiting nurse	165/802	1.84 (1.44–2.35)	1.17 (0.89–1.55)	1.27 (0.90–1.81)
Day care service	94/726	0.70 (0.55–0.90)	0.68 (0.53–0.89)	0.61 (0.44–0.86)
Home helper	122/787	0.95 (0.74–1.20)	0.95 (0.74–1.22)	0.85 (0.62–1.17)
Number of prescription medications (vs <3: death/total = 69/354)				
3–5	97/710	0.65 (0.48–0.89)	0.65 (0.48–0.89)	0.75 (0.48–1.16)
≥6	102/609	0.82 (0.61–1.12)	0.85 (0.62–1.17)	1.04 (0.67–1.61)
Charlson Comorbidity Index (vs <2: death/total = 97/750)				
2–3	112/637	1.56 (1.18–2.06)	1.31 (0.98–1.74)	
≥4	69/286	2.26 (1.65–3.10)	1.44 (1.02–2.02)	
Geriatric Depression Scale-15 score ≥6 (vs <6: death/total = 59/559)‡	109/723	1.42 (1.03–1.95)		1.25 (0.90–1.73)
Presence of chronic diseases (vs absence)				
Ischemic heart disease	30/208	0.89 (0.61–1.30)		0.91 (0.57–1.46)
Congestive heart failure	35/144	1.63 (1.15–2.33)		1.28 (0.79–2.07)
Cerebrovascular disease	94/569	1.01 (0.79–1.30)		0.74 (0.52–1.06)
Diabetes mellitus	39/199	1.25 (0.89–1.76)		1.39 (0.90–2.14)
Dementia	131/591	1.94 (1.53–2.47)		1.63 (1.16–2.30)
Cancer	44/148	2.36 (1.71–3.26)		2.56 (1.68–3.91)
Hypertension	49/406	0.68 (0.50–0.92)		0.77 (0.52–1.14)

* Model 1 includes sex, age, activity of daily living (ADL) status, living arrangement, presence or absence of regular medical checkups, use or nonuse of home care services, number of prescribed medications, and comorbidity status.

† Model 2 includes sex, age, ADL status, living arrangement, presence or absence of regular medical checkups, use or nonuse of home care services, number of prescribed medications, and presence or absence of chronic disease.

‡ n = 1,282.

HR = 1.99, 95% CI = 1.40–2.83; Model 2, HR = 1.74, 95% CI = 1.11–2.74), low ADL function (vs high function, Model 1, HR = 2.38, 95% CI = 1.61–3.51; Model 2, HR = 2.03, 95% CI = 1.27–3.25), Charlson Comorbidity Index of 4 or greater (vs <2, Model 1, HR = 1.44, 95% CI = 1.02–2.02), and presence of dementia (Model 2, HR = 1.63, 95% CI = 1.16–2.30) and cancer (Model 2, HR = 2.56, 95% CI = 1.68–3.91) were associated with 21-month mortality. Alternatively, lower mortality was associated with day care service use (vs nonuse, Model 1, HR = 0.68, 95% CI = 0.53–0.89; Model 2, HR = 0.61, 95% CI = 0.44–0.86), although the multivariate Cox regression model (Model 1) for the 391 participants who could not perform the GDS-15 demonstrated no significant effect of day care service use on 21-month mortality (HR = 0.85, 95% CI = 0.55–1.32). The association between day care service use and lower mortality already observed at 6-month follow-up (vs nonuse, Model 1, at 3 months, HR = 0.51, 95% CI = 0.26–1.01; at 6 months, HR = 0.64, 95% CI = 0.41–0.99; at 9 months, HR = 0.62, 95% CI = 0.42–0.92; at 12 months, HR = 0.62, 95% CI = 0.45–0.86; at 15 months, HR = 0.66, 95% CI = 0.49–0.89; at 18 months, HR = 0.71, 95% CI = 0.54–0.92).

Stratified, multivariate adjusted analyses performed between multiple subgroups showed that day care service use indicated less risk of all causes of mortality in subjects who were female (HR = 0.69, 95% CI = 0.49–0.97); younger than 75 (HR = 0.41, 95% CI = 0.21–0.84); had high ADL function (HR = 0.43, 95% CI = 0.21–0.91), the lowest comorbidity (HR = 0.50, 95% CI = 0.30–0.82), no dementia (HR = 0.60, 95% CI = 0.41–0.88), and depression (HR = 0.54, 95% CI = 0.35–0.82); and used a visiting nurse service (HR = 0.57, 95% CI = 0.40–0.82) (Figure 1).

Figure 2A shows the multivariate adjusted Kaplan-Meier survival curves exploring the association between frequency of day care service use and time to death (3-month intervals). The risk of mortality was lower for participants using day care service two or more times per week than for those using day care service once per week or less. In the Cox regression model adjusted for potential confounders, participants using day care service two and three times or more had 63% or 44% lower relative HRs (HR = 0.37, 95% CI = 0.20–0.67; HR = 0.56, 95% CI = 0.33–0.94, respectively) than participants not using the service (referent group: a simple black square in Figure 2B), although there was no significant association between once-weekly day care service use and risk of mortality (HR = 0.94, 95% CI = 0.61–1.45).

DISCUSSION

In the present study the risk factors for short-term (21-month) mortality of community-dwelling older people with varying physical and mental impairments were investigated. It was demonstrated that the risk factors were being male or aged 85 and older; having low physical function, high comorbidity, dementia, and cancer; and not using day care service. Most of these factors, including male sex, age, low physical function, and high comorbidity, are consistent with the risk factors for mortality in community-dwelling and hospitalized older people identified in previous observations.[14–17] It has been reported that polypharmacy and depression are associated with mortality of older people,[18–21] but in the present study, the number of medications was not identified as a mortality risk for community-dwelling frail older people. Depression was likely to be associated with 21-month mortality in univariate analysis, but this association was not confirmed in multivariate analysis adjusted

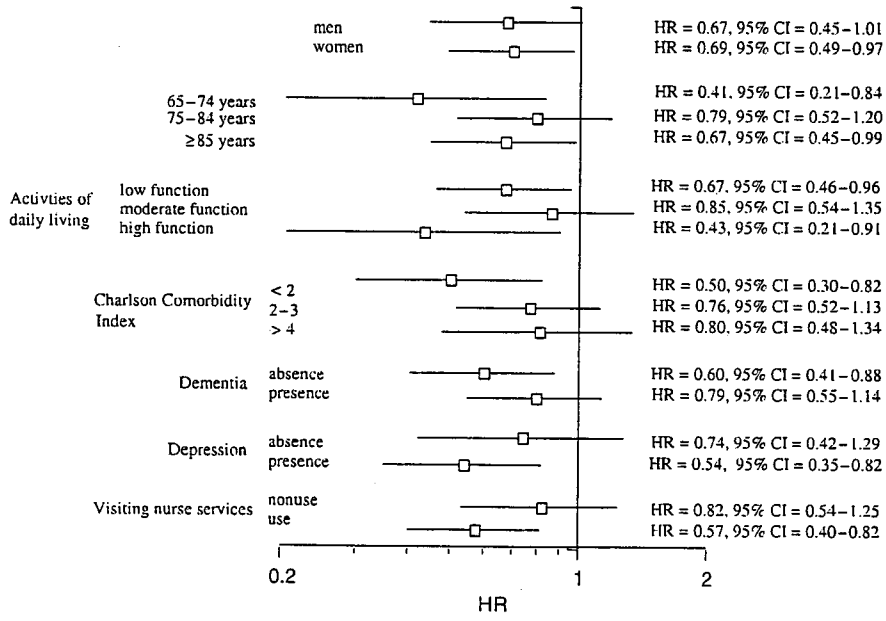

Figure 1. Stratified analysis of the risk of death in participants using or not using day care service. Estimates were obtained from Cox regression models adjusting for sex, age, activity of daily living status, living arrangement, number of medical examinations, visiting nurse and home help service use, number of prescribed medications, and Charlson Comorbidity Index. White squares are estimated hazard ratios (HRs) from a Cox proportional hazards model. The error bars represent 95% confidence intervals (CIs).

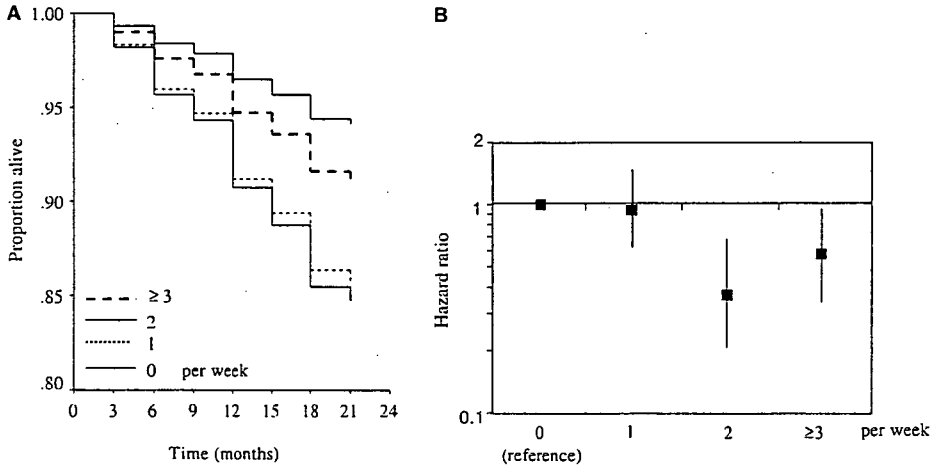

Figure 2. Frequency of day care service use (times per week) and all-cause mortality for community-dwelling frail older people. (A) Kaplan-Meier survival curve over the 21 months according to the frequency of day care service use (times per week), adjusting for sex, age, activity of daily living status, living arrangement, number of medical examinations, visiting nurse and home help service use, number of prescribed medications, and Charlson Comorbidity Index. (B) Risk of death according to frequency of day care service use (times per week) adjusting for potential confounders as described above. *Y*-axis is adjusted hazard ratios on a log scale. Black squares are point estimates from a Cox proportional hazards model adjusting for potential confounders. The error bars represent 95% confidence intervals. A simple black square without confidence intervals represented the referent group, without use of day care service.

for potential confounders. This finding differs from those of several prior studies of community-residing older adults that found that depressive status was an important predictor of mortality.[20,21] There are several possible reasons for this difference between study results. The subjects in the current investigation were probably frailer and at higher mortality risk than those in these prior studies. All had multiple medical problems or functional limitations. These serious health concerns may have been stronger determinants of mortality than depressive status.

Subjects with day care service use had lower mortality in univariate analysis than nonusers, even if day care users had higher Charlson Comorbidity Indexes, higher prevalence rates of dementia, or a history of CVD. Multivariate analysis revealed that day care service use was associated with a 32% to 39% reduction in mortality, independent of sex, age, disability, comorbid condition, number of medications used, and presence of chronic diseases. In contrast, visiting nurse or home help service was not associated with lower mortality.

The finding of no advantage of day care service use for the 391 participants with incomplete GDS-15 measurement in terms of 21-month mortality may suggest that advanced age, significant limitations in physical and cognitive functions, and multiple comorbid conditions attenuate the beneficial effect of day care service on the mortality of community-dwelling older people. In fact, a subgroup analysis clearly showed that the day care service program reduced the 21-month mortality rate significantly in the youngest study populations (65–74). Furthermore, interactions were found between the effect of day care programs on mortality and ADL impairment, comorbidity, presence or absence of dementia and depression, and visiting nurse service use. The protective effect of day care service use is more evident in less-disabled elderly with lower comorbidity, populations without dementia and with depression, and visiting nurse service users. These results indicate that the mortality risk was modifiable by day care programs in the youngest group (65–74) and populations with lower ADL impairment and lower comorbidity, no dementia, and depression. It was also found that the effect of day care service on mortality was much stronger in visiting nurse service users, suggesting that combined service intervention has more effect on the mortality of community-dwelling frail older people.

This study clearly showed that the frequency of day care service use affected its beneficial effect on 21-month mortality; after adjusting for potential confounders, there was no effect of day care service use once a week on 21-month mortality, but there was significantly lower mortality in those using day care service two or more times per week. These results suggest that frequent use of day care service reduces the risk of mortality and that once a week is not enough. This is in contrast to the recent report that risk of nursing home placement increased significantly with the number of days of adult day care attendance in older people with Alzheimer's disease.[22] The exact reason for this beneficial role of day care service and which components of the day care service improve mortality is not clear, but multidisciplinary services conducted in day care service, including nursing care, rehabilitation therapies, supervision and socialization, bathing, and providing meals services, may be involved in the favorable outcome regarding the reduction in death for frail older people. Frequent use of day care services by older people with some disabilities increases the chance that day care staff, including nurses, will detect changes in physical and mental status. Periodic multidimensional evaluation for detection of modifiable risk factors for death and subsequent long-term intervention to modify these risk factors and to identify new risks by care

staff may contribute to the lower mortality. The result that a higher frequency of day care service use was associated with a greater reduction in mortality is consistent with this concept.

Previous studies, most of them with small sample sizes, have failed to find a significant difference between day care (hospital) service and alternative services (domiciliary care provided in patients' homes) in terms of the endpoint of death.[23–25] In a previous systematic review of geriatric day hospital care (defined as an outpatient facility where older patients attend for a full or near full day and receive multidisciplinary assessment and rehabilitation in a health care setting) on the basis of 12 controlled trials,[8] the day hospital patients had better outcomes regarding deterioration in ADLs than those receiving no comprehensive care, although no difference was found with regard to death between individuals receiving care in the day hospital and those receiving no comprehensive care or receiving alternative care. A criticism of studies in day hospitals is the difficulty of researching heterogeneous groups of participants, because the small number of participants limits most studies.[9] The strengths of the current study are its large number of participants and the provision of subgroup analysis, which revealed that certain subgroups respond better than others in a day care setting.

The Program of All-inclusive Care for the Elderly (PACE) was introduced in the United States as a healthcare system that provides comprehensive services for frail community-dwelling older people who meet state criteria for nursing home placement but choose to live at home. PACE provides for all medically indicated care, including all hospitalizations, outpatient medical services, medications, physical and occupational therapy, transportation, adult day health, home health aids, and durable medical equipment, including hearing and vision aids. So far, only limited evaluation of the effect of PACE on reducing the use of institutions and hospital admissions exist.[26,27] It awaits further study demonstrating the effect not only of PACE, but also of the components of the program, such as adult day health center use, on nursing home placement, acute hospital admissions, and mortality of frail older people in the community.

This study has important limitations. It was not conducted using a randomized intervention trial. As described in the introduction, Japan has introduced the LTCI program, which provides various services, including day care service, according to clients' preferences. Therefore, randomization of this service use could not be conducted. Because of the observational design of the present study, differences in unmeasured factors, including the severity of chronic diseases and quality of services, may account in part for the findings. Other aspects of the present study should also be considered. In the analysis, baseline data of the service use have been included, but changes in service use during the follow-up period were not considered. The results may not be representative of frail Japanese older people 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 health practices, ethnic attitudes about caring for very old people, and cost of and access to day care centers may influence these results.

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Falls of the elderly are associated with burden of caregivers in the community†

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SUMMARY

Background Little attention has been paid to the impact on caregivers who provide care to a family member who has falls. The purpose of the current study was to determine whether falls of care recipients are associated with caregivers' burden.
Methods A cross-sectional study of 1874 community-dwelling care recipients and 1478 caregivers was conducted. We examined the characteristics of care recipients and caregivers, including demographic characteristics, depressive mood as assessed by the Geriatric Depression Scale (GDS-15), the basic activities of daily living (bADL), fall history in the past 6 months, and physician-diagnosed chronic diseases to determine whether there was an association with caregivers' burden as assessed by the Zarit Burden Interview (ZBI).
Results A total of 567 care recipients (30.3%) had a history of falls in the past 6 months. The mean ZBI score of caregivers with falls was significantly higher than that of caregivers without falls. There were negative correlations between the ZBI score and recipient bADL score and positive correlations between the ZBI score and GDS-15 scores of the recipient and caregiver, the level of severity of dementia, and the Charlson comorbidity index. Male recipient, fall history, behavioral disturbance, and dementia had significantly higher ZBI scores than those of controls. The stepwise multiple regression analyses found that the GDS-15 score of caregivers and recipients, level of severity of dementia, bADL score, and fall history were independently associated with the ZBI score.
Conclusion Among the community-dwelling frail elderly, falls are associated with caregiver burden even when controlling for various possible confounding factors. Copyright © 2006 John Wiley & Sons, Ltd.

KEY WORDS — falls; caregiver burden; depression; elderly

Family caregivers of frail elderly experience high levels of burden. Numerous studies have found that care-giving is extremely stressful and results in adverse physiological and psychological outcomes for both caregivers and recipients (Schulz and Beach, 1999; Vedhara *et al.*, 1999; Yaffe *et al.*, 2002). It has been demonstrated that various factors including functional or cognitive impairment with behavioral disturbance of care recipients are associated with the caregiver's burden (Pinquart and Sorensen, 2003).

Falls are a significant problem among elderly living not only in the community but also in institutions (Tinetti *et al.*, 1998; Tromp *et al.*, 1998). Falls constitute the largest single cause of injury mortality in elderly individuals (Sattin *et al.*, 1990) and are an independent determinant of functional decline (Tinetti and Williams, 1998), leading to nursing home admissions (Tinetti *et al.*, 1997) and substantial societal costs (Rizzo *et al.*, 1998). In addition, several studies have determined that the consequences of falls include not only physical injury and decline in functional status but also fear of falling, which may lead to restriction in activity or increased dependency (Cumming *et al.*, 2000; Kressig *et al.*, 2001). Thus, falls in frail elderly have been intensively studied in the past decade, but little attention has been paid to the

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impact that providing care to a family member with a fall history has on caregivers. The purpose of this study was to address the following question: are falls of recipients associated with burden of caregivers?

METHODS

Study design and subjects

The present study consisted of a cross-sectional analysis of the baseline data of the participants in the Nagoya Longitudinal Study of the Frail Elderly (NLS-FE). The study population consisted of 1875 community-dwelling frail elderly (men: 632, women: 1243, age 65 years or older) who were eligible for long-term care insurance (LTCI), lived in Nagoya City, and were provided various home care services from the Nagoya City Health Care Service Foundation for Older People, which has 17 visiting nursing stations associated with care-managing centers. Japan introduced a universal-coverage LTCI program in April 2000. The LTCI system covers care for both the elderly aged 65 and older, and for persons aged 40 and older with 15 specific diseases such as cerebrovascular disease and presenile dementia. Under the LTCI program, care levels (level 0–level 5) are determined according to eligibility criteria. The elderly in the community who are eligible for LTCI are frail and chronically ill, have physical and mental problems, and are prone to being admitted to an acute hospital or institutional care setting.

During the registration period (1 November 2003 to 31 December 2003), 1875 of 3630 elderly clients agreed to participate in this study. NLS-FE participants were scheduled to undergo comprehensive in-home assessments by trained nurses at the baseline, 6, 12, and 24 months. In the present study, the cross-sectional data of 1874 among 1875 participants at the baseline were used. One participant was excluded because of a lack of information on the falls experienced. Among 1874 elderly, 1569 participants had caregivers. Ninety-one caregivers were excluded from the analysis because of the lack of their demographic characteristics. Therefore, a total of 1478 caregivers was used for the present study. Informed consent for participation, according to procedures approved by the institutional review board of Nagoya University Graduate School of Medicine, was obtained verbally from the patients or, for those with substantial cognitive impairment, from a surrogate (usually the closest relative or legal guardian), and from caregivers. The research protocol was approved by the institutional review board of the Nagoya University.

Data collection

A total of 328 nurses visited clients' homes and collected data from structured interviews with patients or surrogates, caregivers, and care-managing center records according to the standard instruments. The data included clients' demographic characteristics, depressive symptoms as assessed by the short version of the Geriatric Depression Scale (GDS-15) (Yesavage, 1988), a rating for seven basic activities of daily living (bADL) (feeding, bathing, grooming, dressing, using the toilet, walking, and transferring) using summary scores ranging from 0 (total disability) to 20 (no disability) (Mahoney and Barthel, 1965), and a rating for the instrumental ADL (IADL) scale, which includes five tasks (shopping, housework, meal preparation, taking medications, and managing finances) using summary scores ranging from 0 (total disability) to 8 (no disability) (Lawton and Brody, 1969). The severities of dementia were evaluated according to the criteria provided by the public LTCI policy (Onishi *et al.*, 2005), which are classified into six levels (Level 0–Level 5). The participants were also asked whether they had fallen at least once in the previous 6 months.

Information obtained from care-managing center records included the physician-diagnosed chronic conditions and diseases comprising the Charlson comorbidity index (Charlson *et al.*, 1987), which represents the sum of a weighted index that takes into account the number and seriousness of pre-existing comorbid conditions.

Data were also obtained from caregivers concerning their own personal demographic characteristics, depressive symptoms as assessed by the GDS-15, 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-report inventory that examines the burden associated with functional behavioral impairments in the home care situation. The physical health status of the caregiver was assessed by visiting nurses at the home and classified into three categories: good, fair, and bad.

Statistic analysis

Student's *t*-test, the Mann–Whitney test, and the chi-squared test were used to compare differences between participants who had fallen during the

previous 6 months (fallers) and those who had not fallen (nonfallers). Pearson's linear correlation coefficient (or Spearman's variable, if any) was ordinal and/or not normally distributed for the correlation between the ZBI score and other variables. Partial rank correlation coefficients adjusted for age and gender were also used to measure the relationships between the ZBI score and variables. Student's *t*-test, or an analysis of variance with a Bonferroni correction for multiple comparisons, was used to determine the difference of ZBI scores among groups. To determine which variables were associated with the ZBI scale score, we performed a step-wise multiple linear regression analysis with a forward selection strategy, using an F value with a $p < 0.05$ as the selection criterion. All analyses were performed using the Statistical Package for the Social Sciences (SPSS) Ver-11.0. A probability value of 0.05 or less was considered significant.

RESULTS

The differences of characteristics of care recipients and their caregivers between fallers and nonfallers are presented in Table 1. A total of 567 elderly (30.3%) had a fall history during the previous 6 months. No gender or age differences were detected between fallers and nonfallers. Although a higher mean score of GDS-15 was detected in fallers as compared with nonfallers, no statistically significant differences were observed between the two groups with respect to the status of bADL, IADL, or Charlson comorbidity index. The prevalence of congestive heart failure or dementia was higher in fallers than nonfallers.

Table 1. Characteristics of care recipients and caregivers

	Faller	Nonfaller	*p*
Care recipient variables			
Total number	567	1307	
Men/women (% of men/total)	196/371 (34.6)	436/871 (33.4)	0.611
Age (years), mean (SD)*	80.4 (7.6)	81.0 (7.8)	0.093
Basic ADL (rage, 0–20), mean (SD)†	13.1 (5.5)	12.6 (7.0)	0.313
Instrument ADL (range, 0–8), mean (SD)†	3.2 (2.5)	3.3 (2.7)	0.832
GDS-15(range, 0–15), mean (SD)†	7.0 (3.5)	6.4 (3.7)	0.003
Charlson comorbidity index, mean (SD)†	2.0 (1.6)	1.9 (1.6)	0.153
Level of Severity of dementia (0-5)†	1.2 (1.1)	1.1 (1.3)	0.070
Polypharmacy (% of total)	40.9%	36.8%	0.002
Psychotropic medications (% of total)	33.6%	29.1%	0.064
Chronic diseases (% of total)			
Cerebrovascular disease	35.2%	34.0%	0.611
Hypertension	25.2%	23.8%	0.508
Diabetes mellitus	11.7%	12.1%	0.811
Congestive heart failure	10.6%	7.6%	0.039
Coronary heart disease	12.3%	12.1%	0.924
Dementia	39.9%	33.3%	0.009
Living arrangements			
living alone (%)	22.7%	22.2%	0.810
number of person living with, mean (SD)†	1.7 (1.5)	1.7 (1.6)	0.584
Caregiver variables			
Total number	451	1027	
Men/women (% of men/total)	112/370 (24.8)	277/809 (27.0)	0.337
Age (years), mean (SD)*	64.1 (12.6)	64.0 (12.5)	0.928
Relationship to care recepient			
Child	38.5%	34.5%	
Spouse	38.5%	41.3%	0.477
Daugher-in-low	18.9%	20.3%	
Others	4.2%	4.0%	
GDS-15(range, 0–15), mean (SD)†	5.8 (3.9)	5.4 (3.8)	0.175
ZBI score (range, 0–88), mean (SD)†	31.7 (17.6)	27.6 (16.7)	<0.001

*student *t*-test,
†Mann–Whitney test, Chi-squared test was used for others.
GDS-15: short version of geriatric depression scale, ZBI: Zarit Burden Interview.

Table 2. The correlation between ZBI score and other variables

	Crude		Adjusted*	
	r	*p*	*r*	*p*
Care recipient				
Age	−0.058	0.041	−0.051†	0.079
Basic ADL score	−0.207	<0.001	−0.249	<0.001
Instrumental ADL score	−0.293	<0.001	−0.303	<0.001
GDS-15 score	0.262	<0.001	0.261	<0.001
Level of severity of dementia	0.282	<0.001	0.274	<0.001
Charlson comorbidity index	0.130	<0.001	0.106	<0.003
Caregiver				
Age	0.047	0.104	0.033‡	0.260
GDS-15 score	0.535	<0.001	0.486	<0.001

*adjusted for age and gender of care recipient, and age and gender of caregiver.
†adjusted for gender of care recipient, and age and gender of caregiver.
‡adjusted for age and gender of care recipient, and gender of caregiver.

Table 3. ZBI score comparoson among various groups

	ZBI score			
	n	mean	SD	*p*
Care recipient				
Gender				
Men	452	31.2	17.2	<0.001
Women	805	27.6	16.8	
Age				
65–74 years-old	267	30.9	17.8	0.029
75 years old or older	990	28.4	16.8	
Fall history				
Absence	869	27.6	16.7	<0.001
Presence	388	31.7	17.6	
Behavioral disturbance				
Absence	999	26.3	15.8	<0.001
Presence	256	38.8	18.0	
Chronic diseases				
Dementia				
Absence	650	25.1	16.6	<0.001
Presence	471	33.3	16.5	
COPD				
Absence	1090	28.2	16.8	0.004
Presence	65	34.4	19.0	
Caregiver				
Gender				
Men	300	28.5	17.4	0.628
Women	955	29.1	16.9	
Age				
Younger than 65 years old	567	27.2	16.6	<0.001**
65–74 years old	310	33.1	17.5	
75 years-old or older	301	27.3	16.7	
Relationships of caregiver*				
Child	429	27.2	17.0	0.012†
Spouse	529	30.7	17.9	
Daughter in law	261	28.2	15.2	
Others	35	29.1	15.9	
Physical health status*				
Good	495	24.6	15.9	<0.001‡
Fair	606	31.2	16.4	
Bad	155	33.8	20.0	

*Analysis of Variance, student-*t* test was used for others.
**younger than 65 year *vs* 65–74 year: $p < 0.001$, 65–74 year *vs* 75 year or older, $p < 0.001$.
†child *vs* spouse: $p = 0.008$, others were not significant.
‡good *vs* fair: $p < 0.001$, good *vs* bad: $p < 0.001$, fair *vs* bad: $p = 0.233$.
COPD: chronic obstructive pulmonary disease.

Although the rate of living alone, gender and age of caregivers, relationship of caregivers to care recipients, and GDS-15 scores of caregivers were not different between fallers and nonfallers, the mean ZBI score of caregivers was significantly higher for fallers than for nonfallers.

The correlations between the ZBI score and each of the variables for care recipients and caregivers are presented in Table 2. Although there was a negative correlation between care recipient age and ZBI score, no correlation was observed after adjusting for recipient gender and age and gender of caregiver. No significant correlation was detected between the caregiver's age and ZBI score. There were negative correlations between the care recipient's bADL, IADL, and ZBI scores. Positive correlations were found between GDS-15 scores of both care recipient and caregiver, care recipient level of severity of dementia, or Charlson comorbidity index and ZBI score. These correlations persisted after adjusting for age and gender of care recipient and caregiver.

The comparison of ZBI scores between genders and various groups with statistical difference are presented in Table 3. The following care recipient variables were significantly higher in ZBI scores in comparison with controls: male gender, fall history in the past 6 months, behavioral disturbance, diagnosis of dementia, or chronic obstructive pulmonary disease (COPD). When considering caregiver's variables, the ZBI score of the spouse of caregivers was higher than the ZBI score of the child caregiver, and the caregivers with a poorer status of physical health had a lower ZBI score. The ZBI score of caregivers in the age group of 65–74 years was higher than that in other age groups.

The results of the stepwise multiple regression analyses to identify variables as predictors of subjective burden in caregivers of the frail elderly in the community are presented in Table 4. The care recipient's age and gender, fall history in the past 6 months, GDS-15 and bADL scores, Carlson comorbidity index, level of severity of dementia, and the