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

Table 4. Step-wise multiple linear regression of care recipients' and caregivers' variables on ZBI score

	B	SE	β	p
Caregiver GDS-15	1.899	0.143	0.420	<0.001
Level of severity of dementia	3.151	0.482	0.201	<0.001
Basic ADL score	−0.374	0.091	−0.128	<0.001
Fall experience	3.511	1.069	0.098	0.001
Recipient GDS-15	0.462	0.151	0.097	0.002

$R^2 = 0.334$, adjusted $R^2 = 0.329$.
The following variables were added to the analysis: 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, the presence of COPD, age and gender of caregiver, caregiver's GDS-15 score, type of caregiver–care receiver relationship (spouse or child), and the physical health status of caregiver.

presence of COPD, as well as the age and gender of the caregiver, caregiver's GDS-15 score, type of caregiver-care receiver relationship (spouse or child), and the physical health status of the caregiver were entered into the regression analyses. The best set of predictors of burden, identified by stepwise linear regression, was the caregiver's GDS-15 score, level of severity of dementia, bADL score, fall history in the past 6 months, and care recipient's GDS-15 score. These variables accounted for 33% of the total variance in burden. When the presence of dementia and behavioral disturbance, rather than the level of severity of dementia, were entered into the analysis, the predictors of caregiver's GDS-15 score, presence of behavioral disturbance, bADL score of the care recipient, presence of dementia, fall history, and GDS-15 score of the care recipient were identified (adjusted $R^2 = 0.33$).

DISCUSSION

The present study demonstrated that previous fall history is associated with caregivers' burden. This association persists even when controlling for various possible confounding factors such as ADL status and the presence of chronic diseases including dementia. Although the exact reasons for this association are unknown, it is possible that the majority of caregivers are frightened about their family member falling, and that fall history leads to the psychological distress in the caregiver, which may be related to the caregiver's burden.

Consistent with previous reports (Colerick and George, 1986; Vedhara *et al.*, 1999; Yaffe *et al.*, 2002; Pinquart and Sorensen, 2003), the presence of dementia and behavioral disturbance, physical impairment, and caregiver depressive mood are independent predictors of caregiver burden in the present study. Numerous studies have demonstrated the burden of caregivers of chronic psychiatrically ill elderly, and most are caregivers of demented elderly. It has been reported that depressive symptoms in elderly persons are independently associated with significantly higher levels of informal care-giving, even after adjustment for the effects of major coexisting chronic conditions (Langa *et al.*, 2004). Patient depression was also associated with poor caregiver quality of life (Sewitch *et al.*, 2004). However, few studies had been conducted to examine the association between caregiver burden and recipient depressive mood. One study using a small sample size from outpatient mental clinics reported that patients' behavior and mood disturbance are associated with caregiver burden (Scazufca *et al.*, 2002). In the present study it was clearly demonstrated that care recipient depressive mood is associated with caregiver burden. Although depression is known to be frequently associated with cognitive and physical impairment, this association persists even when adjusting for these factors. Although in this study the level of care-giving was not estimated, it appears that higher levels of care-giving to the depressed elderly reflect the caregiver's burden. It has been reported that depressive mood might be one of the risk factors of falls (Cesari *et al.*, 2002), although we still do not know if depression is a consequence of falls or if depression triggers the fall. Therefore, it is possible that the care recipient depressive mood associated with falls may affect caregiver burden.

Several potential limitations of this study are noted. First, the participants, although a community-based sample, were frail elderly eligible for the LTCI program and, therefore, it may not be possible to generalize the results to healthy elderly. Second, other factors that have been demonstrated to be related to the caregiver's burden, including incontinence of the care recipient (Flaherty *et al.*, 1992) and durations of care-giving (McConaghy and Caltabiano, 2005), were not incorporated into this analysis. Therefore, the possibility exists that a variable omitted from the analysis may contribute to the burden of the caregiver. Economic status and perceived social support may also be related to caregiver burden (Murray *et al.*, 1999). However, the economic status, which was classified into three subjective categories, as well as the number of formal services used, did not correlate with caregiver burden in this study's population (data not shown). Third, the number of falls in the past 6 months was not available in the baseline data of the participants of the NLS-FE. Therefore, the effect of the fall frequency on caregiver burden has not been evaluated.

KEY POINTS

- Little attention has been paid to the impact on caregivers who provide care to a family member who has falls.
- We demonstrated that the fall history in the past 6 months of the frail elderly living in the community, as well as care recipient depressive mood, was associated with caregiver burden.
- Preventing falls is important, not only for the frail elderly but also for their caregivers, to reduce care burden.

In the present study it was demonstrated that fall history in the past 6 months, as well as care recipient depressive mood, is associated with caregiver burden. It appears that preventing falls is important, not only for the frail elderly but also for their caregivers, to reduce care burden. In addition, health care professionals should inquire about the adequacy of social support for their elderly patients with depressive symptoms and should also be alert to potential caregiver burden among the family members who provide care.

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Underuse of Medications for Chronic Diseases in the Oldest of Community-Dwelling Older Frail Japanese

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OBJECTIVES: To test the following hypotheses: (1) the rate of polypharmacy, defined as six or more prescribing medications, is lower in the oldest old (≥85) than in younger older people (65–84); (2) beneficial medication use is lower in the oldest old; (3) the underuse of these medications in the oldest old is associated with physical or cognitive impairment or comorbid conditions.

DESIGN: A cross-sectional study of the baseline data from the Nagoya Longitudinal Study for Frail Elderly.

SETTING: Community-based.

PARTICIPANTS: One thousand eight hundred seventy-five community-dwelling older people (632 men, 1,243 women).

MEASUREMENTS: The data, which were collected at the patients' homes or from care-managing center records, included the clients' demographic characteristics, depression status as assessed using the short version of the Geriatric Depression Scale, a rating for basic activities of daily living (ADLs), prescribed medications, and physician-diagnosed chronic diseases.

RESULTS: The oldest old had less polypharmacy even after controlling for ADLs and comorbid conditions. The underuse of beneficial medications for the oldest old was observed after adjusting for ADLs, cognitive impairment, comorbid conditions, antithrombotic agents for subjects with a history of cardiovascular diseases, acetylcholinesterase inhibitors for those with dementia, and antidepressants for those with depression. However, being aged 85 and older was not associated with the underuse of hypoglycemic and antihypertensive agents by those with diabetes mellitus and hypertension, respectively.

CONCLUSION: Among community-dwelling frail older people, the rate of polypharmacy is lower in the oldest members than in the younger ones. The underuse of prescribed medications for chronic diseases/conditions of frail older people is common but not for all conditions. J Am Geriatr Soc 54:598–605, 2006.

Key words: polypharmacy; undertreatment; elderly

It has been reported that the underuse of medications, defined as the omission of drug therapy that is indicated for the treatment or prevention of a disease or condition, is an important and increasingly recognized problem in older people.[1,2] The underprescribing of drugs seems to have a negative effect on health outcomes for older people,[3,4] but apart from concern about the risks of the excess prescribing of inappropriate or unnecessary drug therapy for older people,[5,6] there is still insufficient knowledge about the adverse consequences associated with the underprescribing of beneficial drug therapies. It is not known whether all kinds of medications are underused in older people or whether specific medications for specific chronic diseases or conditions are selectively underused in older people. In addition, knowledge about the factors that influence the underuse of medications for the common chronic diseases of older people is sparse. There is also a lack of knowledge about how functional and psychological factors influence the use of medication by physicians or how frailty and comorbidity affect drug use by older people.

The national policy in not only Japan but also Western countries is to enable elderly people to retain their independence as long as possible, to have a high quality of life, and to continue living at home as long as they can. It is essential to prevent frail older people from suffering from recurrent diseases and additional illnesses that would require them to receive care in an acute setting or to be admitted to a nursing home or to cause mortality. Therefore, preventive medication for chronic diseases/conditions is important for frail older people living in a community setting.

In the present study targeting frail, community-dwelling elderly persons (≥65), the following hypotheses were tested: (1) the rate of multiple medication use is lower in the oldest people (≥85) than in younger ones (65–84); (2) beneficial medication use for common chronic conditions such as cardiovascular disease (CVD), dementia, depression,

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diabetes mellitus, and hypertension is lower in the oldest people than in younger ones; and (3) the underuse of these medications in the oldest old is associated with physical impairment, cognitive impairment, or comorbid conditions.

METHODS

Study Design and Subjects

The present study consisted of a cross-sectional analysis of 1,875 elderly persons (632 men, 1,243 women) who participated in the Nagoya Longitudinal Study for Frail Elderly (NLS-FE). The study population was community-dwelling older people (≥65) eligible for long-term care insurance (LTCI) who lived in Nagoya City, Japan, 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[7,8] that covers care for people aged 65 and older and people aged 40 and older with 15 specific diseases such as cerebrovascular disease and presenile dementia. Under the LTCI program, care levels (Level 0 to Level 5) are determined according to eligibility criteria. Older people in the community who are eligible for LTCI are frail and chronically ill, have physical and mental problems, and are easy to admit to an acute hospital or institute setting. During the registration period for the NLS-FE (November 1, 2003, to December 31, 2003), 1,875 of 3,630 elderly clients agreed to participate in this study. The NLS-FE participants were scheduled to undergo comprehensive in-home assessments at baseline and 6, 12, and 24 months by trained nurses. In the present study, the cross-sectional data from the baseline assessment were used. Informed consent for participation was obtained verbally from the patients or, for those with substantial cognitive impairment, from a surrogate (usually the closest relative or legal guardian), as well as from caregivers, according to procedures approved by the institutional review board of Nagoya University Graduate School of Medicine.

Data Collection

Three hundred twenty-eight nurses visited the clients' homes and collected the data using standardized interviews with patients or surrogates and caregivers and from care-managing center records. The data included clients' demographic characteristics, depressive symptoms as assessed using the short version of the Geriatric Depression Scale (GDS-15),[9] and a rating for seven basic activities of daily living (ADLs) (feeding, bathing, grooming, dressing, toileting, walking, and transferring), with summary scores ranging from 0 (total disability) to 20 (no disability).[10]

Information obtained from care-managing center records included the following physician-diagnosed chronic conditions: ischemic heart disease, congestive heart failure, liver diseases, cerebrovascular disease, diabetes mellitus, dementia, chronic obstructive pulmonary disease, renal disease, cancer, hypertension, pressure ulcer, depression, and diseases constituting the Charlson Comorbidity Index,[11] which represent the sum of a weighted index that takes into account the number and seriousness of preexisting comorbid conditions. In the present study, only a limited number of subjects diagnosed for depression by a physician according to the care-managing center records were observed. Therefore, the participants were considered to be depressed if their GDS-15 score was 6 or higher.

The data also included the number of prescribed medications and their corresponding therapeutic classes, including antihypertensive drugs, antiplatelets, anticoagulants, antipsychotic medications (including antidepressants), hypoglycemics, nonsteroidal antiinflammatory drugs and acetaminophen, anti-Alzheimer's disease drugs (acetylcholinesterase inhibitors), gastrointestinal medications, and insulin. The information about regular prescribed medications was recorded in interviews with patients and caregivers and taken from prescription records and classified by nurses using standard instruments. Clients eligible for LTCI have their own primary care physicians, who submit a report on their clinical status every 6 months.

Statistical Analysis

Analysis of variance with a Bonferroni correction for multiple comparisons was used to determine differences between age groups (65–74, 75–84, and ≥85) for continuous variables, and the Kruskal-Wallis test was used to test categorical variables. The chi-square test was used to compare the presence of chronic diseases/conditions or the number of prescription medications used between age groups. Univariate and multivariate logistic regression was used to determine which characteristics of older people predicted multiple medication use or the underuse of beneficial medication. For the logistic regression analysis, the ADL score (range 0–20) was categorized into three groups with approximately equal number of participants in each group: high function (≥18), mid function (12–17), and low function (≤11). The number of prescribed medications was also categorized into four groups (0, 1–2, 3–5, and ≥6). All analyses were performed using SPSS version 11.0 (SPSS, Inc., Chicago, IL).

RESULTS

Table 1 shows the characteristics of the participants according to age group. ADL score was lowest in the oldest old (≥85). The prevalence of a history of coronary heart disease, hypertension, and dementia increased, and the prevalence of diabetes mellitus decreased, with age. Polypharmacy, defined as six or more prescribed medications, decreased with age. To identify the factors influencing polypharmacy in frail older people in the community, logistic regression analysis was conducted (Table 2). Participants with congestive heart failure (odds ratio (OR) = 1.66, 95% confidence interval (CI) = 1.09–2.55), coronary heart disease (OR = 3.05, 95% CI = 2.16–4.31), and diabetes mellitus (OR = 1.51, 95% CI = 1.06–2.15) were more likely to be receiving multiple medications according to multivariate analysis. In contrast, participants with dementia were less likely to have been prescribed multiple medications (OR = 0.64, 95% CI = 0.48–0.84). The oldest old had less polypharmacy using univariate analysis (OR = 0.64, 95% CI = 0.49–0.82) and multivariate analysis (OR = 0.55, 95% CI = 0.39–0.77) controlled for sex, ADL dependency, and the presence of common chronic diseases.

Table 1. Characteristics of Community-Dwelling Frail Older People Stratified by Age

Characteristic	Total (N = 1,875)	Age 65–74 (n = 433)	Age 75–84 (n = 827)	Age ≥85 (n = 615)	*P*-value
Men/women (% of men/total)	632/1,243 (33.7)	191/242 (44.1)	275/552 (33.3)	166/449 (27.0)	<.001
Age, mean ± SD*	80.6 ± 7.7	70.5 ± 2.7	79.4 ± 2.8	89.3 ± 3.6	<.001
Activity of daily living score, mean ± SD (range 0–20)†	12.8 ± 6.6	12.6 ± 6.8	13.6 ± 6.3	11.8 ± 6.7	<.001‡
Charlson Comorbidity Index, mean ± SD†	2.0 ± 1.6	2.2 ± 1.7	1.9 ± 1.5	2.0 ± 1.5	.003§
GDS-15 score, mean ± SD (range 0–15)†	6.6 ± 3.6	6.8 ± 3.8	6.5 ± 3.6	6.5 ± 3.6	.38
Chronic diseases (% of total)					
Congestive heart failure	8.5	1.8	6.5	15.7	<.001
Coronary heart disease	12.2	7.0	12.5	15.2	<.001
Cerebrovascular disease	34.3	40.1	32.4	33.1	.03
Diabetes mellitus	12.0	16.1	12.3	8.9	.003
Dementia	34.4	24.8	31.0	45.7	<.001
Hypertension	24.3	19.4	24.5	27.3	.01
Depression (GDS-15 score ≥6)	57.2	58.4	56.7	57.1	.27
Cancer	9.1	9.1	8.8	9.6	.90
Use of medications (% of total)					
0	5.1	3.3	3.3	8.9	<.001
1–2	16.8	14.0	15.7	20.3	
3–5	41.9	41.9	43.2	40.2	
≥6	36.2	40.9	37.8	30.6	

* Analysis of variance or † Kruskal-Wallis was used for analysis; chi-square test was used for others.
‡ Aged 65–74 vs 75–84, $P = .007$; 65–74 vs ≥85, $P = .003$; 75–84 vs ≥85, $P < .001$.
§ Aged 65–74 vs 75–84, $P < .001$; 65–74 vs ≥85, $P = .02$; 75–84 vs ≥85, $P = .08$.
SD = standard deviation; GDS-15 = 15-item Geriatric Depression Scale.

Logistic regressions were conducted to evaluate the extent to which age group and the characteristics of older people were independent predictors of being prescribed essential medications. Univariate analysis showed the rates of prescription of antithrombotic agents (antiplatelet or warfarin), acetylcholinesterase inhibitors, and antidepressants in older people with a history of CVD (including coronary heart disease and stroke), dementia, and depressive symptoms, respectively, declined substantially with age (Table 3), but in participants with diabetes mellitus or hypertension, age did not influence hypoglycemic (oral hypoglycemic drugs or insulin) or antihypertension use. Being female was associated with the underuse of antithrombotic agents in older people with a history of CVD (male: OR = 1.80, 95%

Table 2. Logistic Regression Analysis for Polypharmacy

Characteristic	Univariate Odds Ratio (95% Confidence Interval)	Multivariate Odds Ratio (95% Confidence Interval)
Age (reference: 65–74)		
75–84	0.88 (0.69–1.11)	0.71 (0.53–0.95)
≥85	0.64 (0.49–0.82)	0.55 (0.39–0.77)
Male (reference: female)	1.26 (1.03–1.53)	1.05 (0.82–1.35)
Activity of daily living score (range 0–20) (reference: high function (≥18))		
Mid function (12–17)	1.26 (0.99–1.59)	1.35 (1.03–1.79)
Low function (≤11)	0.94 (0.74–1.19)	1.38 (0.99–1.89)
Presence of chronic diseases (reference: absence)		
Congestive heart failure	1.91 (1.36–2.68)	1.66 (1.09–2.55)
Coronary heart disease	2.65 (1.98–3.54)	3.05 (2.16–4.31)
Cerebrovascular disease	0.96 (0.78–1.18)	1.10 (0.84–1.43)
Dementia	0.59 (0.47–0.73)	0.64 (0.48–0.84)
Diabetes mellitus	1.59 (1.19–2.13)	1.51 (1.06–2.15)
Depression (Geriatric Depression Scale-15 score ≥6)	1.27 (1.02–1.58)	1.26 (0.99–1.59)
Hypertension	0.87 (0.69–1.08)	0.82 (0.62–1.08)

Table 3. Univariate Analysis of Characteristics Associated with Participants Receiving Medication

Characteristic	Antithrombotic Agent Use for History of CVD	Acetylcholinesterase Inhibitor Use for Dementia	Antidepressant Use for Depression	Hypoglycemic Use for Diabetes Mellitus	Antihypertensive Use for Hypertension
	n, Odds Ratio (95% Confidence Interval)				
Age					
65–74	163, 1.00 —	83, 1.00 —	173, 1.00 —	60, 1.00 —	83, 1.00 —
75–84	290, 0.75 (0.51–1.10)	205, 1.00 (0.51–1.94)	348, 0.68 (0.34–1.35)	94, 1.56 (0.73–3.32)	196, 2.05 (0.99–4.27)
≥85	219, 0.48 (0.32–0.73)	202, 0.44 (0.21–0.93)	220, 0.40 (0.16–0.96)	48, 0.55 (0.25–1.26)	155, 1.92 (0.89–4.11)
Sex					
Female	391, 1.00 —	336, 1.00 —	465, 1.00 —	129, 1.00 —	302, 1.00 —
Male	281, 1.80 (1.32–2.46)	154, 0.79 (0.45–1.38)	276, 0.69 (0.36–1.35)	73, 0.75 (0.40–1.41)	132, 0.56 (0.31–1.03)
Activity of daily living score (range 0–20)					
High function (≥18)	167, 1.00 —	74, 1.00 —	237, 1.00 —	59, 1.00 —	160, 1.00 —
Mid function (12–17)	238, 1.14 (0.77–1.70)	180, 0.50 (0.27–0.93)	272, 0.93 (0.45–1.91)	71, 1.27 (0.56–2.88)	143, 0.88 (0.42–1.88)
Low function (≤11)	265, 0.81 (0.54–1.20)	233, 0.13 (0.06–0.28)	232, 0.88 (0.41–1.89)	72, 0.60 (0.28–1.29)	130, 0.57 (0.28–1.16)
Chronic diseases					
Congestive heart failure					
Absence	613, 1.00 —	438, 1.00 —	624, 1.00 —	189, 1.00 —	363, 1.00 —
Presence	59, 0.89 (0.52–1.54)	51, 0.22 (0.05–0.94)	63, 0.51 (0.12–2.15)	13, 0.30 (0.10–0.94)	42, 2.75 (0.64–11.78)
CVD					
Absence		221, 1.00 —	390, 1.00 —	110, 1.00 —	201, 1.00 —
Presence		268, 0.28 (0.16–0.48)	297, 0.48 (0.23–0.97)	92, 0.71 (0.38–1.31)	204, 1.12 (0.61–2.07)
Dementia					
Absence	380, 1.00 —		507, 1.00 —	130, 1.00 —	236, 1.00 —
Presence	268, 0.67 (0.49–0.93)		161, 1.49 (0.73–3.02)	65, 0.48 (0.25–0.91)	154, 0.62 (0.33–1.14)
Depression					
Absence	198, 1.00 —	120, 1.00 —		67, 1.00 —	154, 1.00 —
Presence	297, 1.26 (0.87–1.81)	161, 1.06 (0.54–2.08)		90, 0.65 (0.31–1.37)	184, 1.30 (0.64–2.62)
Diabetes mellitus					
Absence	580, 1.00 —	424, 1.00 —	597, 1.00 —		328, 1.00 —
Presence	92, 0.89 (0.57–1.40)	65, 0.96 (0.45–2.03)	90, 1.18 (0.48–2.90)		77, 0.72 (0.35–1.48)
Hypertension					
Absence	468, 1.00 —	336, 1.00 —	557, 1.00 —	125, 1.00 —	
Presence	204, 0.54 (0.38–0.76)	154, 0.50 (0.27–0.93)	184, 1.14 (0.58–2.27)	77, 1.15 (0.61–2.19)	

CVD = cardiovascular disease.

Table 4. Multivariate Analysis of Characteristics Associated with Participants Receiving Medication

Characteristic	Antithrombotic Agent Use for History of CVD (n = 480)	Acetylcholinesterase Inhibitor Use for Dementia (n = 280)	Antidepressant Use for Depression (n = 668)	Hypoglycemic Use for Diabetes Mellitus (n = 154)	Antihypertensive Use for Hypertension (n = 302)
	Odds Ratio (95% Confidence Interval)				
Age (reference 65–74)					
75–84	0.90 (0.56–1.42)	0.67 (0.25–1.82)	0.59 (0.28–1.26)	1.39 (0.54–3.54)	1.98 (0.75–5.19)
≥85	0.53 (0.32–0.90)	0.21 (0.06–0.71)	0.33 (0.12–0.91)	0.53 (0.19–1.49)	1.48 (0.55–3.98)
Sex (reference female)					
Male	1.57 (1.08–2.30)	1.20 (0.54–2.68)	0.74 (0.35–1.57)	0.93 (041–2.13)	0.79 (0.34–1.80)
Activity of daily living score (reference high function (≥18))					
Mid function (12–17)	1.17 (0.74–1.84)	0.56 (0.24–1.29)	0.91 (0.40–2.03)	1.73 (0.66–4.53)	0.94 (0.39–2.27)
Low function (≤11)	0.94 (0.58–1.54)	0.07 (0.02–0.26)	0.96 (0.40–2.31)	1.28 (0.49–3.58)	0.80 (0.29–2.20)
Presence of chronic disease (reference absence)					
Congestive heart failure	1.18 (0.61–2.27)	0.29 (0.03–2.46)	0.63 (0.14–2.82)	0.26 (0.06–1.01)	1.93 (0.41–9.14)
CVD		0.26 (0.12–0.57)	0.45 (0.21–0.97)	0.95 (0.43–2.10)	1.70 (0.75–3.86)
Dementia	0.92 (0.61–1.39)		1.88 (0.87–4.05)	0.68 (0.28–1.66)	0.73 (0.32–1.65)
Depression	1.25 (0.85–1.84)	1.75 (0.80–3.82)		0.62 (0.27–1.39)	1.54 (0.72–3.29)
Diabetes mellitus	0.56 (0.32–0.99)	0.73 (0.23–2.34)	0.85 (0.31–2.29)		0.77 (0.30–1.97)
Hypertension	0.69 (0.45–1.05)	0.37 (0.15–0.92)	1.40 (065–2.99)	1.28 (0.54–3.03)	

CVD = cardiovascular disease.

CI = 1.32–2.46), and having a higher ADL dependency was associated with the underuse of acetylcholinesterase inhibitors in those with dementia (low ADL function: OR = 0.13, 95% CI = 0.06–0.28). In older people with dementia or diabetes mellitus, those with heart failure were less likely to be prescribed acetylcholinesterase inhibitors (OR = 0.22, 95% CI = 0.05–0.94) and hypoglycemics (OR = 0.30, 95% CI = 0.10–0.94). In older people with dementia or depression, those with a history of CVD were less likely to be prescribed acetylcholinesterase inhibitors (OR = 0.67, 95% CI = 0.49–0.93) and antidepressants (OR = 0.48, 95% CI = 0.23–0.97). The presence of dementia was associated with the underuse of antithrombotic agents and hypoglycemic drugs in older people with a history of CVD (OR = 0.67, 95% CI, 0.49–0.93) and those with diabetes mellitus (OR = 0.48, 95% CI = 0.25–0.91).

Multivariable analysis showed that the oldest age group received fewer antithrombotic agents (OR = 0.53, 95% CI = 0.32–0.90), acetylcholinesterase inhibitors (OR = 0.21, 95% CI = 0.06–0.71), and antidepressants (OR = 0.33, 95% CI = 0.12–0.91) among older people with a history of CVD and those diagnosed with dementia and with depressive symptoms, respectively (Table 4). When a separate analysis was conducted of the participants with a history of stroke and those with a history of coronary heart disease, the oldest age group was less likely to be prescribed antithrombotic agents in subjects with a history of coronary heart disease (OR = 0.29, 95% CI = 0.09–0.91) but not with stroke (OR = 0.66, 95% CI = 0.37–1.19). Analysis also showed that women with a history of CVD were less likely than men with CVD to be prescribed antithrombotic agents (male: OR = 1.57, 95% CI = 1.08–2.30) and that having a low ADL function was associated with the underprescription of acetylcholinesterase inhibitors (low ADL function: OR = 0.07, 95% CI = 0.02–0.26) in older people with dementia. In older people with hypertension or diabetes mellitus, none of the factors studied were associated with the underprescription of antihypertensive or hypoglycemic drugs, respectively. In older people with depressive symptoms, those with a history of CVD were less likely to be prescribed antidepressants (OR = 0.45, 95% CI = 0.21–0.97).

DISCUSSION

In the present study, the presence of various chronic diseases, including congestive heart failure, coronary heart disease, and diabetes mellitus, was demonstrated to influence multiple medication use in community-dwelling frail older people. In contrast, participants with dementia were less likely to be prescribed multiple medications. Whether doctors prescribe differently for patients with cognitive impairment is a controversial issue. Some studies have shown that fewer drugs are prescribed for patients with dementia than for those without,[12,13] but other studies have demonstrated no significant difference between patients with and without dementia in the average number of medications prescribed.[14,15] Nevertheless, it is more important to know the influence of the presence of cognitive impairment on the use of beneficial medication for specific chronic diseases than that on the total number of prescribed medications. This study also showed, using a multivariate logistic regression model controlling for other confounding factors, that the oldest age group (≥85) is less likely to be prescribed multiple medications. It is possible that these oldest patients do not see their primary care physician, even if they have chronic diseases or conditions, but this was found not to be true, because the number of visits they made to their primary physician per month was not a predictor of underuse of medication for chronic diseases and conditions (data not shown). These results prove the hypothesis that the rate of multiple medication use is lower in the oldest community-dwelling frail older people (≥85) than in the younger old.

Previous studies have showed that nursing home residents aged 85 and older are less likely to be treated than those aged 65 to 74 for stroke secondary prevention[16] and that there is a marked underuse of aspirin in the treatment of older patients with documented prior myocardial infarction at the time of admission to a nursing home.[17] In agreement with these studies based at the nursing home, the present study targeting community-dwelling older people demonstrated that the oldest subjects with a history of CVD were less likely to be prescribed antithrombotic agents for secondary prevention. Nevertheless, when a separate analysis was conducted of the participants with a history of stroke and those with a history of coronary heart disease, older age was still a predictor of nonuse of antithrombotic agents in subjects with a history of coronary heart disease but not with stroke. In the present survey, hemorrhagic and ischemic stroke were not differentiated between in the stroke diagnosis. Although ischemic strokes account for 85% of all strokes of persons aged 65 and older according to the Japanese national survey, it is possible the inclusion of hemorrhagic stroke affected the analysis.

In the present study, the oldest group univariate and multivariate analyses indicated underuse of acetylcholinesterase inhibitors by older people with dementia. It is possible that a higher proportion of the oldest elderly might have a severe form of Alzheimer's disease and therefore not be eligible for treatment with acetylcholinesterase inhibitors. Few published studies on the use of antidepressants have focused on the older population, even though the prevalence of depression is high in community-dwelling elderly persons. In the present study, 57.2% of the participants had a GDS-15 score of 6 or higher, although only 2% of the subjects were diagnosed with depression in primary care settings, consistent with reports from other countries that the majority of older people with depression are not diagnosed in primary care.[18,19] Alternatively, potentially effective antidepressant medications are also used inadequately in older populations. According to the data from a national survey in Canada, the rate of antidepressant use was 3.1% in older people in the community. Of those who were depressed, 4.2% were taking an antidepressant.[20] In the current survey, only 5.9% of subjects who had depressive symptoms received antidepressants, and univariate analysis showed that the oldest old with depression were less likely to use antidepressants than those who were younger. The multivariate analysis confirmed this association.

Only several reports on the rate of drug treatment for diabetes mellitus in older people have been found. One cross-sectional study demonstrated that the likelihood of drug treatment for people with diabetes with insulin or oral

hypoglycemics declined substantially with increasing age.[21] In the present study, the use of hypoglycemic agents by older people diagnosed with diabetes mellitus was the lowest in the oldest persons, and in comparison with persons aged 65 to 74, the OR of hypoglycemic use in the oldest old was 0.53 using multivariable logistic regression analysis, although the *P*-value did not reach statistical significance ($P = .23$).

In this population of frail older people living at home, the nonuse of antihypertensive medication was relatively low in older people with hypertension, and no difference in the ratio of the prescription of antihypertensive drugs between age categories was found. Furthermore, no association was detected between the nonuse of antihypertensive medication and any factors tested, not only in the univariate analysis but also in the multivariate analysis. This is in contrast to previous studies showing that older people were likely to be undertreated for hypertension.[22,23]

It has been suggested that ADL impairment, cognitive impairment, and comorbid conditions are factors influencing the underprescription of beneficial agents in older people associated with chronic diseases: the underuse of antithrombotic agents by stroke patients with severe cognitive or physical impairment,[16,24] hypoglycemic agents underuse by older people with diabetes mellitus with higher levels of comorbidity,[21] and the underuse of antihypertensive medication by older people with cognitive impairment or comorbidity.[22,23] Nevertheless, in the current study, even after controlling for ADL dependency and the presence of dementia, age was still a significant predictor of the nonuse of antithrombotic agents by older people with a history of CVD, acetylcholinesterase inhibitors by older people with dementia, and antidepressants by older people with depression. In addition, the present study suggests that the influence of ADL dependency, cognitive impairment, and comorbid conditions on the underuse of beneficial medications was also dependent on each chronic disease/condition. The lowest category of ADL function was only associated with the nonuse of acetylcholinesterase inhibitors by the demented elderly using multivariable logistic regression analysis. The presence of dementia was associated with the nonuse of antithrombotic agents by the participants with a history of CVD in univariate analysis, but multivariate analysis did not confirm this association. Furthermore, no association was detected between the nonuse of antihypertensive medication and the presence of dementia in univariate and multivariate analysis. It is possible that, to avoid the risk of adverse drug reactions, physicians decide not to use beneficial medications for the oldest old, although multiple medication use may not always be a disadvantage for older people with comorbid conditions when drugs with proven efficacy in elderly patients are available. These results suggest again that it is not easy to predict the underuse of prescribed beneficial medication in older persons but is instead complex and dependent on each chronic disease/condition. The history of CVD was associated with the nonuse of acetylcholinesterase inhibitors by older people with dementia using univariate and multivariate logistic regression analysis. It is possible that the origin of dementia for most of them might be vascular.

There are many factors that contribute to the underuse of beneficial medications in the oldest old. The use of age as an indicator of benefit of care is imprecise, in that elderly persons differ appreciably in physical, mental, and cognitive status and in life expectancy. It is of concern that the very population that receives the most medications may not always have a favorable risk/benefit ratio. Physicians may decide not to use a medication, because patients may not benefit from treatment (e.g., the low use of acetylcholinesterase inhibitors by demented older people with the lowest ADL function). In fact, geriatric therapeutics must also take into account specific geriatric diseases (e.g., dementia, CVD) and syndromes (e.g., falls, gait and balance disturbances, incontinence, ADL impairment). As proposed by others,[25] the lack of high-quality evidence derived from clinical studies with relevance to treating older patients with multiple chronic medical conditions may be one of the factors that contribute to the underuse of beneficial medications in the oldest old. In fact, clinical evidence often does not provide a definitive answer on the benefits or risks of many drug therapies in older people, especially in those aged 75 and older.[26] Of a number of chronic diseases common in older people, the evidence for drug therapy has been accumulating in the field of hypertension faster than with other diseases. This may be one of the reasons that the highest prescription rate is for antihypertensive medication and the reason there is no restriction of treatment in the oldest patients.

A recent study indicated that the cost of prescription drugs is another problem contributing to the undertreatment of diseases in older people.[27] These cost-related problems seem to be dependent on health insurance systems, which vary between countries. In Japan, universal mandatory health insurance, which covers nearly all regular health care, including prescription drugs, covers the entire population. Elderly health insurance for people aged 75 and older or aged 65 and older with some impairments covers health care, including prescription drugs, with a 10% copayment. Therefore, it is unlikely that cost problems influenced these results or that their influence, if any, was great.

The major limitation of this study was that diagnoses of chronic diseases were based solely on information available in the care-managing centers' records, which were based on the data provided by primary care physicians every 6 months. The accuracy of the diagnosis of chronic diseases by these physicians was not evaluated. It was also not discovered how severe these chronic conditions, which included dementia, diabetes mellitus, and hypertension, were. The results may not be representative of frail older Japanese 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 treating very old people, and cost/access to medications may influence these results. Because of the small numbers of participants with each chronic condition, these observations cannot be commented on conclusively. The findings of this study need to be reproduced in a larger sample of practices.

In summary, it was demonstrated that, among community-dwelling frail older people, the rate of multiple medication use is lower in the oldest persons than in the younger ones. In addition, the underuse of beneficial medication for the oldest persons in this group was observed: antithrombotic agents by subjects with a history of CVD,

acetylcholinesterase inhibitors by subjects with dementia, and antidepressants by subjects with depression. Nevertheless, the oldest persons with diabetes mellitus and hypertension were not associated with the underuse of hypoglycemic and antihypertensive agents, respectively. Thus, the underuse of prescribing medication for chronic diseases/conditions of frail older people living in the community is common but not for all conditions.

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健康長寿と運動

Advances in Aging and Health Research 2005

KEIRIN
競輪補助事業

財団法人 長寿科学振興財団

スポーツと長寿

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はじめに

本項のテーマは「スポーツと長寿」である。章全体のテーマが「運動する人は長生きする」とあり、あとに、「日常生活活動」あるいは「余暇・趣味」と「長寿」との関連が述べられるため、はじめに本項で論ずる「スポーツ」という語の扱いについて確認する。

スポーツ（Sports）という語は、古代フランス語のDesportの派生語である中世英語Desportに由来し、意味は1.おもしろく遊ぶ、2.仕事からの離脱、3.気晴らしなどで、本来のスポーツは仕事以外に余暇として楽しく、朗らかにおこなわれたものという。しかし今日的には、「スポーツ」は、このようなレクリエーション（recreation）の意味合いだけでなく、競技の意味がかなり多く含まれている。これより水野は、現代で用いられる「スポーツ」という語を、気晴らし、競技性などを含んだ多様性のある身体運動を指すと定義している[1]。

本項は、この定義に倣い「スポーツ」として、競技性のあるアスリート（athlete）のスポーツだけでなく日常生活の中での運動習慣も含めて捉え、長寿との関係を示す。

1.競技スポーツと寿命

スポーツなどの運動は、長寿の達成に不可欠な「健康」と密接に関連することがこれまでに多くの研究で確認され、健康を支える柱の一つとして考えられている。しかし、スポーツが「寿命」の延長に影響するかについて

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は未だ明確な結論は得られていない。これは、ヒトの寿命が決定されるには何十年もの時間を要し、また運動以外の生活習慣や環境の大きく影響することが要因の一つと考えられている[2)]。競技スポーツに着目すると、19世紀後半から20世紀前半頃には激しい身体的・精神的ストレスを伴うため、スポーツ選手は短命であると信じられていた。この時代に欧米ではスポーツと寿命に関する古典的な研究が興り、その時代の代表的なスポーツであるボートレースに出場していた選手は一般人に比べ寿命の長いことが示されている。しかし、有名大学に在籍した人と一般人を比較したことが問題とされ、その後続いた調査においても寿命にはスポーツの影響よりも時代差や年代差あるいは体格や喫煙の影響の大きいことが指摘された[2)]。比較的最近に報告された研究では、フィンランドの男性を対象に社会背景要因や結婚歴、年齢などで調整したスポーツの種目と寿命との関連が検討されている。その結果、クロスカントリーなどの持久性スポーツの選手、サッカーなどのチームスポーツの選手、レスリングなどのパワー系スポーツの選手、一般人の順で寿命の長いことが示された[3)]。しかし、これまでのところ競技スポーツ選手の寿命が一般人よりも長いことを示す極めて有力な報告はほとんどみられない。

2.体力と寿命

次に、競技に限らない習慣的に行うスポーツ・運動と寿命との関連について考える。スポーツ・運動習慣は、体力の向上に結びつく。文部科学省では、毎年全国的な体力テストを行っているが、運動習慣の有無に分けてテストの総得点を比較すると、いずれの年代においても運動習慣のある人はない人に比べて体力は高い(図1)[4,5)]。

Blairらは、スポーツ・運動習慣と結びついている体力と死亡率との関連から、スポーツの寿命への影響を検討した。彼らは、運動習慣の指標となる体力を有酸素作業能力として捉え、トレッドミルによる運動の継続時間の成績を五分位に分け、全死亡率や心疾患、がんなどのよる死亡率との関係を検討した。13000人あまりのアメリカ人男女について、約8年間の追跡調査から死亡リスクを算出したところ、年齢を調整しても体力の最も低い人では死亡率の高いことが示された[6)]。

日本における運動習慣と寿命に関する疫学的な研究はまだ少ないが、澤田らは、ガス会社従業員の男性約10000人のエアロバイクによる有酸素能力の成績をもとに、14年間の追跡調査から体力と死亡率の関係を検討した。年齢や体格、高血圧の有無、尿蛋白陽性の有無等を調整して分析した結果、最も体力の低い群に対し、体力の高い群で死亡リスクの低いことが確認された[7)]。

以上の結果は、運動習慣を持ち体力を高く維持することが寿命の延長に繋がる可能性を示している。

3.運動の継続と寿命

1) 運動習慣の変化と死亡率

運動習慣と寿命との関連では、一時点での運動習慣が寿命と関連するとする報告もあるが[8)]、運動習慣の変化と死亡率の関連を検討したハーバード大学卒業生約15000人を対象とした調査も興味深い。約10年の追跡調査から生活習慣と死亡率の関係について分析し、或る時点の運動習慣と死亡率との関連をみる

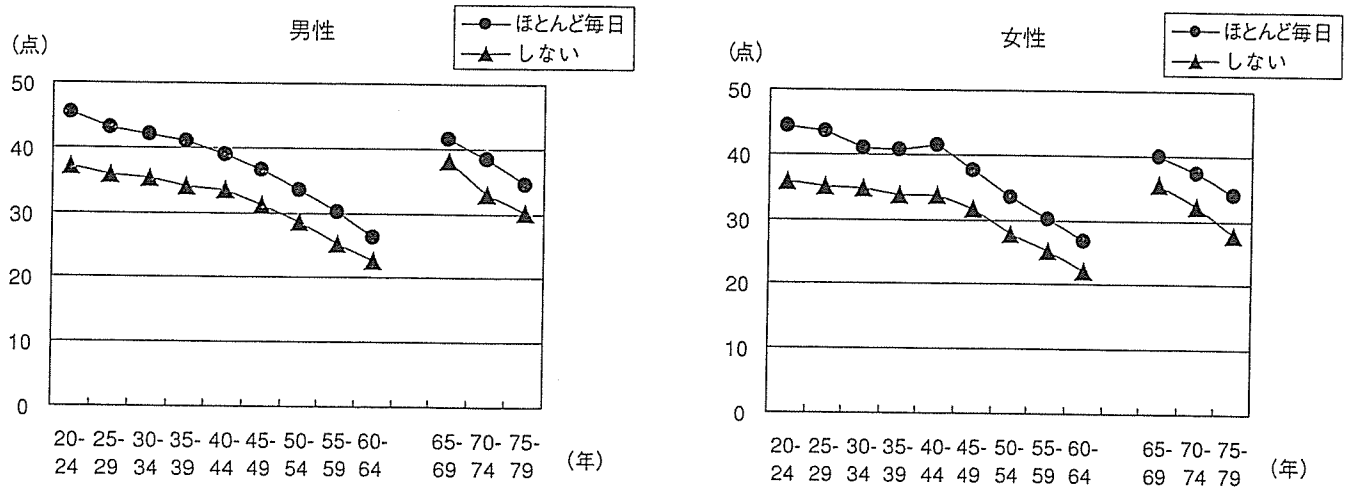

図1. 運動・スポーツの実施別新体力テスト合計点(20～79歳)[4,5]

だけでなく、運動習慣の変化と死亡率との関連を検討している。初回調査と約10年後の調査時においていずれの時点も4.5METs以上のスポーツ活動を全く行っていない人を基準にすると、初回にスポーツ活動を行っていても10年後に行っていない人では死亡リスクが上がり、初回はスポーツ活動を行っていなくても10年後の時点で行っていた人では死亡リスクの下がることを報告している[9]。また、中高年男性約6000人の12-14年の追跡調査では、追跡期間中を通じて活動性の低い人に比べ、活動性を高く維持した人では最も死亡リスクが低かった。また調査開始時点で活動性が低くとも追跡時点で活動性の高かった人は生活習慣や年齢などを調整しても死亡リスクの低いことが示された。調査開始時点で活動性が高くとも追跡時点で活動性の低くなっていた人は、追跡期間中を通じて活動性の低い人と死亡リスクは変わらず、ある時点で活動的であっても継続されなければ寿命の延長には結びつかないことを示した[10]。運動習慣の継続が、寿命の延長に関わることが示唆されている。

2) スポーツ種目と寿命

大澤は日本におけるスポーツ種目と寿命との関連を検討し、格技に注目した考察の中で外来のボクシングやレスリングの選手では必ずしも寿命は長くないが、日本古来のスポーツである剣道や柔道を行う人で寿命の長いことを指摘している。武道は主となる運動能力は瞬発性やパワーとされ、先に示した有酸素能力の重要な持久性スポーツで寿命が長いとする結果とは矛盾しているように思われる。しかし、最近は減少しているとも聞くが、武道は地域にある道場が主な活動の場となり、青年時代に競技生活を送った人は競技に出場しない状態でも生涯の間練習を続ける人が多い。このような練習の継続が、寿命の延長に関連していることが推察されている[2]。持久性スポーツの選手で寿命が長いとする結果も、ジョギングなどに代表される持久性のスポーツは心肺機能の向上が得られるだけでなく、継続しやすい種目であることが寿命の延長に関連しているとも考えられる。