

Table 2 General characteristics of studied aged peoples

Age category	N	%	Necessity of reconstruction of residence	
65-74 years old	1597	60.0	No	2180 81.9
75 years old and more	1064	40.0	Yes	481 18.1
Sex	N	%	Necessity of reconstruction for entrance	
Female	1549	58.2	No	2570 96.6
Male	1112	41.8	Yes	91 3.4
TAI for mobility	N	%	Necessity of reconstruction for bathroom	
0	7	0.3	No	2395 90.0
1	11	0.4	Yes	266 10.0
2	16	0.6	Necessity of reconstruction for toilet	
3	124	4.7	No	2448 92.0
4	320	12.0	Yes	213 8.0
5	2183	82.0	Necessity of reconstruction for hallway	
TAI for eating	N	%	No	2510 94.3
0	6	0.2	Yes	151 5.7
2	4	0.2	Necessity of reconstruction for living room	
3	12	0.5	No	2604 97.9
4	44	1.7	Yes	57 2.1
5	2595	97.5	Type of residence	
TAI for toileting	N	%	Single house	2547 95.7
0	6	0.2	Group house	114 4.3
1	2	0.1	Type of household	
2	14	0.5	Extended family	1191 44.8
3	22	0.8	Aged couple	1089 40.9
4	70	2.6	Single	381 14.3
5	2547	95.7	Ownership of residence	
TAI for bathing	N	%	Own house	2492 93.6
0	6	0.2	Rent house	44 1.7
1	10	0.4	Public house	92 3.5
2	21	0.8	Others	33 1.2
3	45	1.7	Oldness of residence	
4	141	5.3	No	
5	2438	91.6	-5 years	153 5.7
TAI for house affairs	N	%	6-20 years	562 21.1
0	33	1.2	21-30 years	993 37.3
1	375	14.1	31 years -	928 34.9
2	60	2.3	Unknown	25 0.9
3	360	13.5	Past or present history of CVA	
4	217	8.2	No	2482 93.3
5	1616	60.7	Yes	179 6.7
Present history of OMD	N	%	No	2135 80.2
No	2135	80.2	Yes	526 19.8
Yes	526	19.8		

TAI: Typology of Aged with Illustration
 CVA: Cerebro-vascular diseases
 OMD: Osteo-muscular diseases

Table 3 Relationship between type of residence ownership and necessity of reconstruction

Type of ownership		Necessity of reconstruction		Total
		Yes	No	
One own house	N	2039	453	2492
	%	81.8	18.2	100.0
Rented Housing	N	44	0	44
	%	100.0	0.0	100.0
Public Housing	N	67	25	92
	%	72.8	27.2	100.0
Others	N	30	3	33
	%	90.9	9.1	100.0
Total	N	2180	481	2661
	%	81.9	18.1	100.0

Chi square test: $p < 0.01$.

Table 4 Relationship between type of household and necessity of reconstruction

Type of household		Necessity of reconstruction		Total
		Yes	No	
Extended family	N	973	218	1191
	%	81.7	18.3	100.0
Aged couple	N	881	208	1089
	%	80.9	19.1	100.0
Single	N	326	55	381
	%	85.6	14.4	100.0
Total	N	2180	481	2661
	%	81.9	18.1	100.0

Chi square test: $p = 0.12$.

ied peoples. The mean age was 73.8 (SD: 6.4) and 40% were over 75 years old. Female occupied 58.2%. So far as ADL independency is concerning, 80% were independent for mobility, 60% for house affairs, and more than 90% for eating, toileting and bathing. Past or present history of cerebro-vascular diseases were observed for 6.7% and present history of osteo-muscular diseases were for 19.8%. Eighteen percent of investigated persons indicated the necessity of reconstruction of their residence. The most frequent place that required reconstruction was bathroom (10.0%) followed by toilet (8.0%), hallway (5.7%), entrance (3.4%) and living room (2.1%).

Table 3 shows the relationship between type of residence ownership and necessity of reconstruction. Interestingly, persons in public housing indicated more the necessity of reconstruction with statistical significance ($p < 0.01$, chi square test).

Table 4 shows the relationship between type of household and necessity of reconstruction. Although the aged of single household showed a slightly higher response for necessity of reconstruction, there was no statistically significant relationship between the two variables.

Table 5 shows the relationship between type of residence ownership and type of household. The aged

Table 5 Relationship between type of household ownership and type of household

Type of household		Type of ownership				Total
		One's own house	Rented housing	Public housing	Others	
Extended family	N	1159	15	10	7	1191
	%	97.3	1.3	0.8	0.6	100.0
Aged couple	N	1040	12	35	2	1089
	%	95.5	1.1	3.2	0.2	100.0
Single	N	293	17	47	24	381
	%	76.9	4.5	12.3	6.3	100.0
Total	N	2492	44	92	33	2661
	%	93.6	1.7	3.5	1.2	100.0

Chi square test: $p < 0.01$.

Table 6 Analysis concerning factors associated with the willingness to use institutional services (Logistic regression analysis)

	Beta	SD	Wald	p-value	OR	95% CI of OR	
age_cat	0.059	0.086	0.463	0.496	1.061	0.895	1.256
SEX	-0.112	0.099	1.264	0.261	0.894	0.736	1.087
CVA	-0.138	0.168	0.675	0.411	0.871	0.626	1.211
OMD	0.132	0.105	1.593	0.207	1.141	0.930	1.401
Mobility	0.156	0.078	4.030	0.045	1.169	1.004	1.361
House affairs	0.005	0.035	0.018	0.893	1.005	0.939	1.075
Reconstruction	0.261	0.103	6.414	0.011	1.298	1.061	1.588
Dummy for single	0.442	0.123	12.939	0.000	1.555	1.223	1.978
Dummy for aged couple	0.216	0.088	5.958	0.015	1.241	1.043	1.476
Constant	-1.303	0.357	13.299	0.000	0.272	0.135	0.547

Dependent variable: Wish to use institutional services covered by medical insurance or LTCI
Yes = 1, No = 0

Independent variables: age_cat age category: 65 to 74 = 0, 75 and more = 1

Sex: male = 0, female = 1

CVA Past or present history of Cerebro-vascular disease: no=0, yes=1

OMD Present history of Osteo-muscular diseases: no=0, yes=1

Mobility Independency for mobility measured by TAI: lowest = 0, highest = 5

House affaires Independency for house affaires measured by TAI: lowest = 0, highest = 5

Reconstruction Necessity of reconstruction of residence: no=0, yes=1

Dummy for single: no single household=0, single household=1

Dummy for aged couple: no aged couple household=0, aged couple household=1

of single household lived in the public housing more than other types of household with statistical significance ($p < 0.01$).

Table 6 shows the results of logistic regression analysis concerning factors associated with the willingness to use institutional services covered by the public medical insurance and LTCI. Statistically sig-

nificant higher odds ratios of willingness to use were observed for independency of mobility (OR = 1.169, 95% of CI = 1.004 – 1.361), necessity of reconstruction (OR = 1.298, 95% of CI = 1.061 – 1.588), single household (OR = 1.555, 95% of CI = 1.223 – 1.978), and aged couple household (OR = 1.241, 95% of CI = 1.043 – 1.476).

❖ Discussion

Our results clarified that the aged living in the houses with necessity of reconstruction have showed more willingness to use institutional services that are covered by the public medical insurance and LTCL. The Japanese generous health insurance scheme covers most of institutional fee (only 10% of co-payment for the aged). So that to live in hospital is a cheaper, safer and thus reasonable choice for the frail aged. In the case of single female aged, it is very often the case that they can receive only the lowest level of pension because most of them do not receive the additional pension by occupational settings⁷⁾. As our previous study has indicated⁵⁾, the frail aged prefers to stay in hospital as long as possible, because a hospital becomes a kind of comfortable and safe residence for them. This explanation fits well why the aged categorized as single or aged couple household showed more inclination to use the institutional services in the present study.

This type of hospitalization has long been criticized as the hospitalization with social reason. The MHLW estimates that at least one third of long hospitalized aged patients might be such cases. The hospitalization with social reasons cost expensive for the society even though it would be a rational and reasonable choice for the individual aged.

In order to solve this problem, the MHLW has launched the 2006 Health Care Reform Plan in which they put much importance on the development of home care. The MHLW has clarified their will to transform one third of long term care beds into nursing homes and assisted livings. However, under the actual situation, most of the users do not welcome such a program, because it will transfer the financial, psychological and physical burden to the aged and their family. In order to solve this problem, it is absolutely necessary to assure the comfort and safety at home. Hayakawa reported that many aged people in the lower socio-economic class were obliged to live in old and narrow-spaced houses⁸⁾. He also reported that the aged peoples were often denied to borrow a house because of their age and health problems. This is one of the reasons why the Japanese aged prefer to stay in hospital even though the medical problem does not require it.

It must be beard in mind that the current difficult situation has been partly caused by the poor housing

policy of our country. In most of the developed countries, such as UK and France, the development of residence has been organized as a part of social security policy.

On the contrary, the Japanese government has long depended on the private initiative for the construction of residence. During the highly economic development era, the preparation of residence for workers and their family was an important fringe benefit of welfare services organized by company. Furthermore, workers were recommended to do saving in order to construct their own house. The company prepared a variety of supportive services, such as a saving account with higher interest rate and a special loan with low interest rate. During this historical process, the public housing tended to be for the relatively lower economic classes. Furthermore, the public housing had characteristics of "temporary residence" and inhabitants were expected to quit the public housing after they become afford to obtain their own private residence. Thus most of the public housing have not paid enough attention to the vulnerable groups such as the aged and handicapped. The present result also showed that the aged living in the public housing responded the necessity of reconstruction the most frequently. It is very important to recognize that the single household aged live dominantly in the public housing.

The above explanation indicated that the Japanese poor housing policy for the vulnerable groups is one of the most important reasons for overuse of institutional services. In order to ameliorate the quality of life of such aged and at the same time to rationalize the expenditures for medical and ADL care services, the government is required to implement the appropriate housing program for the vulnerable groups. Initially, such a program cost to some extent, but it will save the money for the social security system in the long run.

As Hayakawa has indicated, the healthy housing is a fundamental of public health policy⁸⁾. After the great works by Snow and Chadwick, the healthy housing has long been a part of public health policy in UK⁹⁾. The WHO/Europe focuses the housing program at the WHO Centre for Environment and Health (Bonn office). Currently they address the following priority issues¹⁰⁾:

home safety and accidents
indoor air quality

thermal comfort and energy
residential environments and physical activity
effects on mental health
the challenge of ageing populations

Unfortunately, the housing policy has long been separated from the public health policy in Japan, and as a result, the healthy housing policy is not included in the Healthy Japan 21 plan.

Appropriate housing protects the inhabitants from heat, cold, damp, hazardous pollutants and other risk factors for health⁹⁾. As the 2003 summer scandal in France indicated^{Note}, poor housing affects the vulnerable groups most. It is strongly recommended to integrate the housing policy into the public health policy in order to realize a healthy aged society.

❖ Note

The 2003 European heat wave was one of the hottest summers on record in Europe. The heat wave killed 14,802 French people, mostly elderly. Most homes of them and retirement homes were not equipped with air conditioning.

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Analysis of the Relationship between Depression and Changes in ADL Status among the Japanese Aged

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Abstract

In 2006 the Ministry of Health, Labor and Welfare (MHLW) has launched the 2006 Health care reform plan. One of the characteristics of this plan is to value the preventive activities. Most of these programs mainly focus to the disease specific symptoms and outcomes such as pain, weakness of muscle, and little attention is paid to the mental depression. In order to evaluate the effect of depressive situation on changes in Activity of Daily Living (ADL) level, we have organized and analyzed a two year's panel data (2004–2005) that contains about 1800 aged living in a city of western Japan. For evaluation of ADL level and depression status, Typology of Aged with Illustration (TAI) and Geriatric Depression Scale five item version (GDS5) were used, respectively. After evaluating the results of descriptive analyses, logistic regression analyses were conducted in order to analyze the factors associated with aggravation of ADL levels between 2004 and 2005. The results indicated that depressive status has significant influence on changes in ADL independency status, that is, the person with higher depression situation showed the higher possibility of worsening the ADL level. higher depression situation were related to the worsening of mobility (OR=0.749, 95%CI=0.655–0.857), mental status (OR=0.606, 95%CI=0.489–0.750), eating (OR=0.603, 95%CI=0.458–0.793), toileting (OR=0.564, 95%CI=0.456–0.698), and bathing (OR=0.647, 95%CI=0.551–0.760). The results of our study have suggested that the health promotion activities for the aged must pay enough attention for the depression problem in order to improve and to maintain their ADL independency.

Key words: depression, ADL, aged, prevention, Japan

❖ Introduction

Japan has a universal coverage of public pension, medical insurance and Activity of Daily Living (ADL) care insurance (Long term care insurance; LTCI). Along with the rapid ageing of society, today, the aged are responsible for one half of medical expenditures. For example, the medical expenditures for the aged was 16.5 trillion USD (1USD=100 JY) in 2004¹⁾.

In addition to the medical expenditures, the aged used 50 trillion USD for pension²⁾, and 5.6 trillion for LTCI coverage³⁾. These expenditures for social security system will expand more rapidly within the coming 10 years, because the post-war baby boomers will enter their third age.

Thus, it is an urgent task for the Japanese government to re-organize the social security system in order to make it sustainable under the coming highly aged society. In 2006 the Ministry of Health, Labor and Welfare (MHLW) has launched the 2006 Health Care Reform Plan⁴⁾. One of the characteristics of this plan is to value the preventive activities. As a main program of health promotion, for example, "Health checkups and healthcare advice with a particular focus on the metabolic syndrome" program has been intro-

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duced from 2008. All public health insurers have to organize health check-up and the following health promotion programs for the insured over 40 years old. The main target of screening is "Metabolic syndrome". If an insured is evaluated as high risk, he/she must follow a standardized disease management program that is offered by the health support organization contracted with the insurers.

For LTCI, the special program for maintenance and amelioration of ADL status has been introduced^{5,6}. The slightly frail aged has to receive the preventive ADL services. As the osteo-muscular problems i.e., knee-joint disorders, are the most important reasons for them to receive LTCI services, the physical fitness program is included in the new scheme.

Most of these programs mainly focus to the disease specific symptoms and outcomes such as pain, weakness of muscle, and little attention is paid to the mental depression. Chapman et al have indicated that depressive disorders assume an important role in the etiology, course and outcomes associated with chronic diseases⁷. Based on the results of previous articles, we have hypothesized that the same relationship may exist between depression and ADL independency levels among the Japanese aged. To test this hypothesis, we have organized a panel data that contains about 1800 aged living in a community of western Japan. In this article, we present the results of this study.

❖ Studied Population and Method

The population studied was inhabitants of a city of Fukuoka prefecture. The 2,000 inhabitants more than 65 years old were randomly selected from citizen registration by the city council. We have received data from 1,821 peoples with sufficient information both for 2004 and 2005. There was no case of rejection in 2004. Reasons of exclusion in 2005 were as following; 36 were already institutionalized, 27 moved outside the city, 23 died and 57 were due to insufficient information. There were no significant differences between the included and excluded persons for the distribution of age and sex distribution.

The trained interviewers visited to chosen inhabitants and gathered information using a structured questionnaire from June to September 2004 and 2005. The questionnaire composes of items regarding demographic data (sex, age, address), health status,

ADL (Typology of Aged with Illustration: TAI^{8,9}), and Depression status measured by GDS5 (Geriatric Depression Scale five item version)¹⁰.

After evaluating the results of descriptive analyses, we conducted a series of logistic regression analysis in order to clarify the factors associated with aggravation of ADL levels between 2004 and 2005. Independent variables and dependent variables are as follow:

Independent variables

Age category:

0 = 65–74 years old, 1 = 75 years old and more

Sex:

0 = Male, 1 = Female

CVD (Cerebro-vascular diseases):

0 = No disability due to CVD,

1 = Disability due to CVD

OMD (Osteo-muscular diseases):

0 = No OMD, 1 = Existence of OMD

Other diseases:

0 = No other diseases,

1 = Existence of other diseases

Depression score:

0 = highest level of depression,

5 = lowest level of depression

Dependent variable

Change in each of TAI score (Mobility, Mental status, Eating, Toileting, Bathing, House affairs):

0 = maintained/improved, 1 = worsened

The name of studied people was excluded from the data for analysis in order to assure the privacy.

The statistical analyses were conducted by SPSS 14.0J.

The ethical board of University of Occupational and Environmental Health approved this study and the written consent was obtained from all participants after the explanation of objectives of study by document.

❖ Results

Table 1 shows the demographic status of studied population. The mean and standard deviation were 74.3 ± 5.9 for male, 74.3 ± 5.9 for female and 74.3 ± 5.9 for total. For the age distribution, persons in 70s were the largest (1021, 56.1%), followed by 60s (414, 22.7%), 80s (347, 19.1%) and 90s (39, 2.1%). The percentage of female increased after 80s (more than

Table 1 Sex and age distribution of studied population

Age category		65-69	70-79	80-89	90-	Total
Male	N	177	434	126	13	750
	% age	23.6	57.9	16.8	1.7	100.0
	% sex	42.8	42.5	36.3	33.3	41.2
Female	N	237	587	221	26	1071
	% age	22.1	54.8	20.6	2.4	100.0
	% sex	57.2	57.5	63.7	66.7	58.8
Total	N	414	1021	347	39	1821
	% age	22.7	56.1	19.1	2.1	100.0
	% sex	100.0	100.0	100.0	100.0	100.0

Table 2 Prevalence rates of chronic diseases by sex

		CVA	HD	OMD	Others	Total
Male	N	83	116	132	497	750
	%	11.1	15.5	17.6	66.3	100.0
Female	N	83	116	132	497	750
	%	5.5	15.3	36.6	66.9	100.0
Total	N	83	116	132	497	750
	%	7.8	15.4	28.8	66.7	100.0

CVA: Cerebro-vascular diseases, HD: Heart diseases, OMD: Osteo-muscular diseases.

60%).

Table 2 shows the prevalence rate of chronic diseases. The cerebro-vascular diseases were more dominant among the male elderly (11.1% vs 5.5%). On the contrary, the osteo-muscular diseases were more dominant among the female elderly (36.6% vs 17.6%). About 15% of both sex had the heart diseases and 67% had other diseases such as hypertension and diabetes mellitus.

Table 3 shows the distribution of ADL level measured by TAI. Each item in the TAI has six hierarchical status (5 to 0), representing levels of disability in each domain. Five represents no disability and 0 represents extreme disability. For mobility level, 1420 (78.0%) persons were categorized into "5", 288 (15.8%) were "4", 93 (5.1%) were "3", 9 (0.5%) were "2", 7 (0.4%) were "1" and 4 (0.2%) were "0". Male persons showed a higher percentage of level 5 (83.6% vs 74.0%).

For mental status, 1762 (96.8%) persons were categorized into "5", 43 (2.4%) were "4", 6 (0.3%) were

"3", 4 (0.2%) were "2", 3 (0.2%) were "1" and 3 (0.2%) were "0". There was no apparent sex difference in distribution.

For eating independence, 1790 (98.3%) persons were categorized into "5", 20 (1.1%) were "4", 4 (0.2%) were "3", 3 (0.2%) were "2", 0 (0.0%) were "1" and 4 (0.2%) were "0". There was no apparent sex difference in distribution.

For toileting independence, 1741 (95.6%) persons were categorized into "5", 56 (3.1%) were "4", 11 (0.6%) were "3", 6 (0.3%) were "2", 4 (0.2%) were "1" and 3 (0.2%) were "0". There was no apparent sex difference in distribution.

For bathing independency, 1629 (89.1%) persons were categorized into "5", 142 (7.8%) were "4", 30 (1.6%) were "3", 11 (0.6%) were "2", 6 (0.3%) were "1" and 3 (0.2%) were "0". There was no apparent sex difference in distribution.

For independency of house affairs, 1052 (58.3%) persons were categorized into "5", 194 (10.7%) were "4", 245 (13.5%) were "3", 32 (1.8%)

Table 3 ADL independency level of studied population

			0	1	2	3	4	5	Total
Mobility level	Male	N	2	5	3	35	78	627	750
		%	0.3	0.7	0.4	4.7	10.4	83.6	100.0
	Female	N	2	2	6	58	210	793	1071
		%	0.2	0.2	0.6	5.4	19.6	74.0	100.0
	Total	N	4	7	9	93	288	1420	1821
		%	0.2	0.4	0.5	5.1	15.8	78.0	100.0
Mental status	Male	N	1	0	0	2	24	723	750
		%	0.1	0.0	0.0	0.3	3.2	96.4	100.0
	Female	N	2	3	4	4	19	1039	1071
		%	0.2	0.3	0.4	0.4	1.8	97.0	100.0
	Total	N	3	3	4	6	43	1762	1821
		%	0.2	0.2	0.2	0.3	2.4	96.8	100.0
Eating independence	Male	N	2	0	2	3	12	731	750
		%	0.3	0.0	0.3	0.4	1.6	97.5	100.0
	Female	N	2	0	1	1	8	1059	1071
		%	0.2	0.0	0.1	0.1	0.7	98.9	100.0
	Total	N	4	0	3	4	20	1790	1821
		%	0.2	0.0	0.2	0.2	1.1	98.3	100.0
Toileting independence	Male	N	1	3	2	5	28	711	750
		%	0.1	0.4	0.3	0.7	3.7	94.8	100.0
	Female	N	2	1	4	6	28	1030	1071
		%	0.2	0.1	0.4	0.6	2.6	96.2	100.0
	Total	N	3	4	6	11	56	1741	1821
		%	0.2	0.2	0.3	0.6	3.1	95.6	100.0
Bathing independence	Male	N	1	5	2	14	53	675	750
		%	0.1	0.7	0.3	1.9	7.1	90.0	100.0
	Female	N	2	1	9	16	89	954	1071
		%	0.2	0.1	0.8	1.5	8.3	89.1	100.0
	Total	N	3	6	11	30	142	1629	1821
		%	0.2	0.3	0.6	1.6	7.8	89.5	100.0
Independence of housing affairs	Male	N	7	240	14	184	68	237	750
		%	0.9	32.0	1.9	24.5	9.1	31.6	100.0
	Female	N	7	34	18	61	126	825	1071
		%	0.7	3.2	1.7	5.7	11.8	77.0	100.0
	Total	N	14	274	32	245	194	1062	1821
		%	0.8	15.0	1.8	13.5	10.7	58.3	100.0

were "2", 274 (15.0%) were "1" and 14 (0.8%) were "0". There was an apparent sex difference in independency level. Only 31.6% of male persons were categorized into level 5.

Table 4 shows the changes in each of ADL level between 2004 and 2005. For mobility, 11.1% of level 5 and 7.6% of level 4 decreased in independency. For

house affairs, 12.0% of level 5, 12.9% of level 4, 18.0% of level 3 and 15.6% of level 2 decreased in independency. For other ADL items, such as mental status, eating, toileting and bathing, most of studied elderly kept their independency level between the two years.

Table 5 shows the results of depression score. On

Table 4 Changes of ADL level between 2004 and 2005

		0	1	2	3	4	5	Total
Mobility level in 2004								
Maintained/Improved	N	4	5	9	89	266	1263	1636
	%	100.0	71.4	100.0	95.7	92.4	88.9	89.8
Worsened	N	0	2	0	4	22	157	185
	%	0.0	28.6	0.0	4.3	7.6	11.1	10.2
Mental status in 2004								
Maintained/Improved	N	3	3	3	6	40	1721	1776
	%	100.0	100.0	75.0	100.0	93.0	97.7	97.5
Worsened	N	0	0	1	0	3	41	45
	%	0.0	0.0	25.0	0.0	7.0	2.3	2.5
Eating independence in 2004								
Maintained/Improved	N	4	0	3	4	20	1765	1796
	%	100.0	0.0	100.0	100.0	100.0	98.6	98.6
Worsened	N	0	0	0	0	0	25	25
	%	0.0	0.0	0.0	0.0	0.0	1.4	1.4
Toileting independence in 2004								
Maintained/Improved	N	3	4	4	9	53	1703	1776
	%	100.0	100.0	66.7	81.8	94.6	97.8	97.5
Worsened	N	0	0	2	2	3	38	45
	%	0.0	0.0	33.3	18.2	5.4	2.2	2.5
Bathing independence in 2004								
Maintained/Improved	N	3	6	8	27	129	1548	1721
	%	100.0	100.0	72.7	90.0	90.8	95.0	94.5
Worsened	N	0	0	3	3	13	81	100
	%	0.0	0.0	27.3	10.0	9.2	5.0	5.5
Independence of housing affairs								
Maintained/Improved	N	14	270	27	201	169	935	1616
	%	100.0	98.5	84.4	82.0	87.1	88.0	88.7
Worsened	N	0	4	5	44	25	127	205
	%	0.0	1.5	15.6	18.0	12.9	12.0	11.3

Table 5 Depression score of the studied population

	Mean	SD	Min	Max
Male	4.4	0.9	0	5
Female	4.3	1.0	0	5
Total	4.3	1.0	0	5

average, the studied persons were in relatively good conditions. There were no apparent sex differences in the scores.

Table 6 shows the comparison of score of depression score stratified by existence of CVA, heart dis-

eases, OMD and other diseases. The depressive status were more apparent for the persons with CVA ($p < 0.001$; Mann-Whitney's U), heart diseases ($p = 0.002$), and OMD ($p < 0.001$).

Table 7 shows the results of multivariate logistic regression analysis about the factors associated with aggravation of ADL level. For mobility level, persons ≥ 75 years old (OR=1.663, 95%CI=1.333-2.076), with CVD (OR=1.872, 95%CI=1.130-3.101), OMD (OR=1.932, 95%CI=1.394-2.676), other diseases (OR=2.102, 95%CI=1.427-3.097) and higher depression situation (OR=0.749, 95%CI=0.655-0.857) showed a significantly higher probability of deces-

Table 6 Depression score stratified by existence of diseases

		N	Average rank	Rank sum	Mann-Whitney's U	p
CVA	No	1679	926.6	1555743.0	93035.0	0.000
	Yes	142	726.7	103188.0		
HD	No	1541	925.7	1426498.5	193092.5	0.002
	Yes	280	830.1	232432.5		
OMD	No	1297	941.1	1220582.0	300799.0	0.000
	Yes	524	836.5	438349.0		
Other diseases	No	607	955.3	579867.0	341559.0	0.004
	Yes	1214	888.9	1079064.0		

CVA: Cerebro-vascular diseases, HD: Heart diseases, OMD: Osteo-muscular diseases.

ing independency.

For mental status, persons ≥ 75 years old (OR=3.672, 95%CI=1.796–7.511) and with higher depressive situation (OR=0.606, 95%CI=0.489–0.750) showed a significantly higher probability of decreasing independency.

For eating independency, persons with CVD (OR=3.719, 95%CI=1.507–9.178), higher depressive situation (OR=0.603, 95%CI=0.458–0.793), and ≥ 75 years old (OR=2.938, 95%CI=1.151–7.501) showed a significantly higher probability of decreasing independency.

For toileting independency, persons with CVD (OR=2.814, 95%CI=1.355–5.847), higher depressive situation (OR=0.564, 95%CI=0.456–0.698), and ≥ 75 years old (OR=4.540, 95%CI=2.079–9.913) showed a significantly higher probability of decreasing independency.

For bathing independency, persons with CVD (OR=2.008, 95%CI=1.095–3.683), heart diseases (OR=1.915, 95%CI=1.188–3.086), OMD (OR=1.884, 95%CI=1.228–2.889), higher depressive situation (OR=0.647, 95%CI=0.551–0.760), and ≥ 75 years old (OR=2.152, 95%CI=1.367–3.388) showed a significantly higher probability of decreasing independency.

For independency of housing affairs, persons with OMD (OR=1.638, 95%CI=1.193–2.248), ≥ 75 years old (OR=2.072, 95%CI=1.527–2.811) and male (OR=0.726, 95%CI=0.535–0.985) showed a significantly higher probability of decreasing independency.

Discussion

The present results have indicated that people with chronic disease condition, such as disability due to CVA and OMD show significantly higher depressive status. The most interesting finding of our study is that the depressive status has significant influence on changes in ADL independency status, that is, the person with higher depression situation showed the higher possibility of worsening the ADL level.

These findings are consistent with most of the previous literatures. Husaini and Moors reported that arthritis disability was significantly influential to depression and life satisfaction among the elderly¹¹. Another literature has indicated that depression and/or anxiety are among the most commonly reported concerns by persons with arthritis¹².

For stroke, there are several reports indicating that persons with depressive symptoms show statistically significant higher possibility to have a stroke. In addition to being a predictor of stroke, depression commonly develops after a stroke. For example, Berg et al clarified that more than half of patients experiencing a stroke reported depressive symptoms within 18 months of having a stroke¹³. Furthermore, post-stroke depression has been associated with increased mortality up to two years following the stroke¹⁴.

Increased rate of depression have consistently been associated with diabetes¹⁵. Depressive symptoms have been associated with diabetes-related complication¹⁵, and social adaptation of diabetic patients¹⁶.

As these literatures have indicated, there would be no doubt that depressive disorders assume an impor-

Table 7 Factors associated with worsening of mobility level

		Beta	SE	Wald	OR	95% of OR
Mobility	Age category	0.509	0.113	20.285	1.663	1.333–2.076
	CVD	0.627	0.258	5.923	1.872	1.130–3.101
	OMD	0.658	0.166	15.679	1.932	1.394–2.676
	Other Diseases	0.743	0.198	14.116	2.102	1.427–3.097
	Depression score	-0.289	0.069	17.795	0.749	0.655–0.857
Mental status	Depression score	-0.501	0.109	21.143	0.606	0.489–0.750
	Age category	1.301	0.365	12.698	3.672	1.796–7.511
Eating	CVD	1.314	0.461	8.124	3.719	1.507–9.178
	Depression score	-0.506	0.140	13.068	0.603	0.458–0.793
	Age category	1.078	0.478	5.079	2.938	1.151–7.501
Toileting	CVD	1.035	0.373	7.693	2.814	1.355–5.847
	Depression score	-0.572	0.109	27.771	0.564	0.456–0.698
	Age category	1.513	0.398	14.418	4.540	2.079–9.913
Bathing	CVD	0.697	0.309	5.075	2.008	1.095–3.683
	Heart diseases	0.650	0.243	7.116	1.915	1.188–3.086
	OMD	0.633	0.218	8.426	1.884	1.228–2.889
	Depression score	-0.436	0.082	28.223	0.647	0.551–0.760
	Age category	0.766	0.231	10.959	2.152	1.367–3.388
House affairs	OMD	0.493	0.162	9.319	1.638	1.193–2.248
	Age category	0.729	0.156	21.909	2.072	1.527–2.811
	Sex	-0.321	0.156	4.218	0.726	0.535–0.985

Independent variables

- Age category: 0: 65–74 years old, 1: 75 years old and more
 Sex: 0: Male, 1: Female
 CVD (Cerebro-vascular diseases): 0: No disability due to CVD, 1: Disability due to CVD
 OMD (Osteo-muscular diseases): 0: No OMD, 1: Existence of OMD
 Other diseases: 0: No other diseases, 1: Existence of other disease
 Depression score: 0: lowest level of depression, 4: highest level of depression

Dependent variable

- Change in each of TAI score: Mobility, Mental status, Eating, Toileting, Bathing, House affairs
 Score: 0: lowest, 5: highest

tant role in the etiology, course and outcomes associated with chronic diseases.

The Health Care Reform Plan 2006 in Japan values preventive activities. However, most of programs under the new scheme focus to the physically functional improvement and do not pay enough attention to depression and/or depressive symptoms. Although a positive effect of physical activity on mental status have been reported¹⁷⁾, more interventions such as depression prevention program will be needed.

Ageing is the process of losing. Along with time, the aged peoples lose their health, family members, role in occupational and social life. All these events

of losing would cause the depression or depressive symptoms for the aged. In order to realize an active aged society, thus, it is necessary to implement the more integrated programs that cover whole life aspect of the aged. Especially we think that necessary is the program facilitating the social participation of the aged. Along with the large scale intra-immigration along with the economic development after the Second World War, most of the Japanese communities have lost the social tie. Expansion of nuclear family has deprived the traditional familial role of the aged.

Japan belongs to the high suicide countries around the world. Especially the suicide rate is very

high among the aged. It is well known that there are depression or depressive conditions behind most of the suicide cases. Depression caused by the losing process may contribute to the high suicide prevalence among the Japanese aged.

Therefore, we have to re-create the opportunities of social participation for the aged. Under the Confucianism tradition, the Japanese values the work. It is reported that the Japanese aged have very high willingness to continue to work¹⁸⁾. The economic aspect is not the most important reason for them. They want to work in order to keep the relationship with the society. Crimmins et al have showed that the working aged people keep their physical and mental health compared with the non-working aged¹⁹⁾.

In order to promote physical and mental health of the aged, it will be one reasonable solution to extend the retirement age up to 70 years old or more drastically to abandon the retirement age²⁰⁾. Most of the employees are reluctant to this proposal, because it may mean the higher labor cost relative to productivity. It will be necessary to re-organize the wage structure and labor contract that permit to balance cost and productivity.

Another solution is to create small works for the aged in the community, such as gardening, house-keeping, teacher-assistant in the public school, assistant work in the agricultural sector. We call this policy as "new work-fare program" and it is beginning in some communities and by NPOs as voluntary basis. In fact, most of the programs indicated that the participating aged people are becoming more active.

There are some limitations for this study. First, as we used self-evaluation on diagnosis and depression situation, the existence of information bias cannot be excluded. For example, depressive person might evaluate their ADL level less than the objective level. Second, we did not obtain information on a number of important possible confounding and pathway variables, including smoking, drinking, physical exercise, nutritional intake, economic status, education status, marital condition and formal/informal care. For example, the economic situation is one of the most anxious issues among the aged and might be associated with depression and accessibility of ADL and formal care. This limited adjustment weakens the conclusion. Third, the study population is relatively small to derive a definitive conclusion. These limitations must be taken into account for evaluation of the

present study.

In conclusion, the results of our study have suggested that the depressive status has significant influence on changes in ADL independency status. The health promotion activities for the aged must pay enough attention for the depression problem in order to improve and to maintain their ADL independency.

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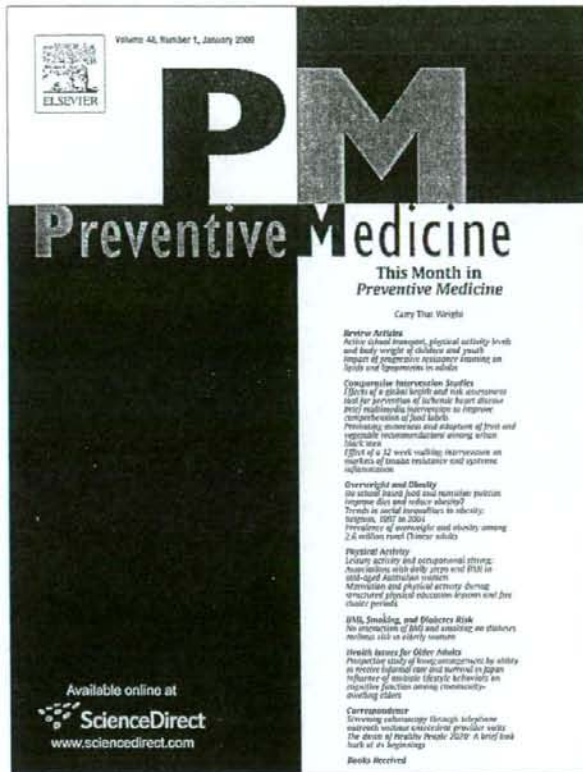
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Prospective study of living arrangement by the ability to receive informal care and survival among Japanese elderly

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ABSTRACT

Objectives. In light of recent concerns regarding informal care, we examined the association between living arrangement and survival among elderly Japanese, with living arrangement measured in terms of the ability to receive informal care from the immediate family.

Methods. A total of 3000 subjects aged 60 years or older were randomly recruited in Yukuhashi City, Japan, in 2002, of whom 2773 provided complete information for analysis. A trained local welfare commissioner visited the subjects annually from 2002 to 2007 and collected information concerning living arrangements, mobility status, medical status, and use of long-term care insurance service. During the 5 years of follow-up, 381 deaths were recorded.

Results. Living arrangement was not associated with survival among elderly women. In contrast, compared with men living with others able to provide care throughout the day, mortality was higher for those living with others unable to provide sufficient care due to illness or infirmity; those living with others receiving long-term care insurance service; and those living alone without support from family or friends (multivariable hazard ratio=1.40, 95% Confidence Interval 0.94–2.09; hazard ratio=1.89, 95% Confidence Interval 1.07–3.34; and hazard ratio=5.76, 95% Confidence Interval 2.16–15.36; respectively).

Conclusion. We found that living arrangement as classified by the ability to receive informal care affects survival among elderly men.

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Introduction

The increased life expectancy of Japanese, which averaged 83 years (male 79, female 86) in 2006 (World Health Organization, 2008) and is now the longest in the world, probably owes to long-term improvements in social environment, such as in the economy, hygiene, education, peacekeeping, and security. Nevertheless, the increase in expectancy has been accompanied by social problems related to the aging of the population.

Informal care for the elderly is thus an important public health concern, particularly with regard to service delivery, care costs, care provision, and long-term care insurance. Japan introduced long-term care insurance in 2000 (General Affairs Division et al., 2002), with an initial number of elderly certified to receive long-term care from 1.5 million, increasing to 3.2 million in 2005 (Statistics and Information Department et al., 2006a, 2006b). Further, a declining fertility rate has increased the ratio of nuclear families among the elderly population, with families of two increasing from 20% in 1988 to 30% in 2006, and elderly people living alone from 15% of all elderly aged 65 or over in 1988 to 22% in 2006 (Statistics and Information Department et al., 2006a, 2006b).

Despite public concern about the effect of living arrangements on the elderly and the ability to receive informal care, we are unaware of any study that has examined the health effects of living arrangements in these terms. Of the few studies which examining the effect of living arrangement on health (Brown et al., 2002, Davis et al., 1997, Davis et al., 1992, Gliksmann et al., 1995, Iliffe et al., 1992, Joung et al., 1994, Lawton et al., 1984, Magaziner et al., 1988, Murata et al., 2005, Sarwari et al., 1998), only a few were prospective (Davis et al., 1997, Davis et al., 1992, Iliffe et al., 1992, Joung et al., 1994, Magaziner et al., 1988, Sarwari et al., 1998), and results have been inconsistent. Moreover, only one study has been conducted among Japanese elderly, which showed that aged Japanese women living alone were better off in terms of mortality than those in multi-generation households (Murata et al., 2005).

Here, we prospectively examined the association between living arrangement and survival among elderly Japanese, with living arrangement measured in terms of the ability to receive informal care from the immediate family.

Material and methods

Study subjects

A total of 3000 subjects were randomly identified from resident registry data held by the municipal office of Yukuhashi City, Fukuoka

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	Category	Explanation
Living with other(s)	Living with others who provide care throughout the day	Subject lives with other(s) who usually stay at home throughout the day and who is potentially able to provide care if needed.
	Living with others who cannot provide sufficient care due to illness or infirmity	Subject live with other(s) who usually stay at home but cannot provide sufficient care due to illness or infirmity.
	Living with others who cannot provide sufficient care due to a job	Subject lives with other(s) who works either full- or part-time. Subject usually stays at home alone for a certain time per day.
	Living with another who is receiving long-term care insurance service	This category particularly indicates a "family of two", in which either a spouse or nonspouse is receiving long-term care insurance service, regardless of subject's receipt himself/herself of long-term care insurance service.
Living alone	Living alone with frequent support from family and friends	Family and friends frequently visit and provide support to a subject who lives alone.
	Living alone without support from family or friends	Subject lives alone, but is rarely visited by family or friends.

Fig. 1. Living arrangement categories.

Prefecture, Japan in 2002, representing approximately 10% of the elderly aged 60 years or older across five school districts. Enrollment was restricted to subjects living at home, and excluded those living in nursing homes. Twenty-seven subjects declined participation in the study and 200 were excluded owing to extended hospitalization or stay in a nursing home. Finally, 2773 (1178 males and 1595 females) provided complete information for analysis. A trained local welfare

commissioner visited the subject at home and collected information using a questionnaire administered by face-to-face interview. Information was collected annually from 2002 to 2006. Information about the use of long-term care insurance was provided by the city municipal office, and the vital status of each participant was checked using data held at the municipal office. Follow-up surveys on survival were conducted until August 2007. Participants were censored on the

Table 1
Characteristics of participants by year (Yukuhashi City, Japan, 2002–2006)

	Men					Women				
	Baseline (2002)	2nd wave (2003)	3rd wave (2004)	4th wave (2005)	5th wave (2006)	Baseline (2002)	2nd wave (2003)	3rd wave (2004)	4th wave (2005)	5th wave (2006)
Number of subjects	1178	1155	1096	1060	985	1595	1584	1545	1529	1468
Living arrangement (%)										
Living with others who provide care throughout the day	82	79	78	81	76	55	49	46	57	49
Living with others who cannot provide sufficient care due to illness, or infirmity	8	10	11	8	10	16	17	18	11	13
Living with others who cannot provide sufficient care due to a job	4	4	4	3	4	11	11	12	11	13
Living with others who were receiving long-term care insurance service	2	2	3	3	4	3	4	4	3	5
Living alone with frequent support from family and friends	4	4	5	5	4	14	18	19	17	17
Living alone without support from family or friends	0 ^a	1	1	0 ^a	1	1	1	1	2	3
Mobility ^b (%)										
Level 5	87	86	83	83	83	80	77	72	73	75
Level 4	8	8	11	12	8	13	16	20	21	12
Level 3	4	5	5	4	5	5	5	7	5	9
Level 2	0 ^a	1	0 ^a	0 ^a	2	1	1	1	1	2
Level 1	0 ^a	0 ^a	1	0 ^a	1	1	1	1	0 ^a	1
Level 0	0 ^a	0 ^a	0 ^a	0 ^a	1	0 ^a	0 ^a	0 ^a	0 ^a	1
Medical status (%)										
In hospital	0 ^a	0 ^a	0 ^a	0 ^a	1	0 ^a	0 ^a	0 ^a	0 ^a	1
Receiving periodical outpatient treatment	64	68	70	60	65	68	74	78	68	68
Without any medical care	36	32	30	40	34	32	26	22	32	31
Use of long-term care insurance (%)	5	7	8	10	11	11	12	13	16	19

^a Less than 1%, but not zero.

^b level 5, ability of the elder to climb stairs without aid or assistive devices; level 4, cannot climb stairs without aid but can walk on flat surface without aid or assistive devices; level 3, cannot walk on a flat surface without aid, but can move around using assistive devices and perform transfer independently while seated; level 2, cannot either move around or transfer while seated using assistive device or aid from the others, but can sit up and maintain seated position; level 1, cannot either sit up or maintain seated position but can roll over on the bed without aid; and level 0, cannot roll over on a bed while lying without aid.

Table 2
Baseline characteristics according to living arrangements (Yukuhashi City, Japan, in 2002)

	Men						Women					
	Living with others who provide care throughout the day	Living with others who cannot provide sufficient care due to illness, or infirmity	Living with others who cannot provide sufficient care due to job	Living with others who were receiving long-term care insurance service	Living alone with frequent support from family and friends	Living alone without support from family or friends	Living with others who provide care throughout the day	Living with others who cannot provide sufficient care due to illness, or infirmity	Living with others who cannot provide sufficient care due to job	Living with others who were receiving long-term care insurance service	Living alone with frequent support from family and friends	Living alone without support from family or friends
Number of subjects	963	97	45	21	47	5	879	249	82	44	227	14
Age mean	72.3	76.2	74.7	81.0	77.3	69.2	73.4	72.5	74.7	76.2	75.7	74.0
SD	5.7	6.3	7.8	8.4	6.8	4.4	6.8	6.2	7.1	7.1	6.5	6.2
Mobility ^a (%)												
Level 5	91	62	80	43	72	100	85	83	74	55	71	64
Level 4	6	19	7	29	15	0	10	11	16	34	32	21
Level 3	2	17	13	14	11	0	4	4	9	2	7	7
Level 2	0 ^b	0	0	5	0	0	0 ^b	1	0	7	0 ^b	0
Level 1	0	1	0	5	2	0	0 ^b	1	1	0	0	0
Level 0	0 ^b	2	0	5	0	0	0 ^b	0	0	2	0	7
Medical status (%)												
In hospital	0 ^b	0	0	5	2	0	0 ^b	0	0	0	0	0
Receiving periodical outpatient treatment	61	79	67	86	72	40	62	72	74	68	80	71
Without any medical care	39	21	33	10	26	60	37	28	26	32	20	29
Use of Long-term Care Insurance (%)	2	11	7	38	9	0	4	5	5	30	11	0

^a Level 5, ability of the elder to climb stairs without aid or assistive devices; level 4, cannot climb stairs without aid but can walk on flat surface without aid or assistive devices; level 3, cannot walk on a flat surface without aid, but can move around using assistive devices and perform transfer independently while seated; level 2, cannot either move around or transfer while seated using assistive device or aid from the others, but can sit up and maintain seated position; level 1, cannot either sit up or maintain seated position but can roll over on the bed without aid; and level 0, cannot roll over on a bed while lying without aid.

^b Less than 1%, but not zero.

date of death or 31 August 2007, whichever came first, giving 11639 person-years (4830 males and 6810 females) of follow-up. During the 5 years of follow-up, 381 deaths (225 males and 156 females) were recorded.

Informed consent is obtained from the participants and the study is approved by the Ethics Committee of University of Occupational and Environmental Health, Japan.

Measurement

Living arrangement categories used in this study are shown in Fig. 1. Living arrangements were categorized into six groups by the ability to receive informal care from family members, namely living alone without support from family or friends; living alone with frequent support from family and friends; living with others who were receiving long-term care insurance service; living with others who cannot provide sufficient care due to a job; living with others who cannot provide sufficient care due to illness or infirmity; and living with others able to provide care throughout the day.

Mobility status was measured according to the Typology of the Aged with Illustrations, a validated instrument for the measurement

of elderly function (Okochi, 2005; Okochi et al., 2005a, 2005b; Takahashi et al., 2001), as follows: level 5, able to climb stairs without aid or assistive devices; level 4, cannot climb stairs without aid but can walk on flat surfaces without aid or assistive devices; level 3, cannot walk on a flat surface without aid, but can move around using assistive devices and change position independently while seated; level 2, cannot move around or transfer while seated using an assistive device or aid from others, but can sit up and maintain a seated position; level 1, cannot sit up or maintain a seated position but can roll over on bed without aid; and level 0, cannot roll over on a bed while lying without aid.

Medical status was categorized into three groups: not receiving medical care; receiving periodic outpatient treatment; and hospitalized.

Statistical analysis

Sex-specific hazard ratios (HR) were estimated by an extended Cox model with time-dependent variables (Cox and Oakes, 1984; Kleinbaum, 2005). We used three models: age-adjusted model included living arrangement and age; model 1 included age, mobility and medical status; model 2 included age, mobility, medical status, and

Table 3
Hazard ratios of living arrangement for mortality among men (Yukuhashi City, Japan, 2002–2007)

	Person year	Number of deaths	Death rate ^a	Age-adjusted ^b			Model 1 ^b			Model 2 ^c					
				HR	95% CI	p	HR	95% CI	p	HR	95% CI	p			
Total	4830	225	47												
Living with others who provide care throughout the day	3888	149	38	Reference			Reference								
Living with others who cannot provide sufficient care due to illness, or infirmity	435	33	76	1.52	1.03	2.24	0.04	1.40	0.94	2.09	0.10	1.39	0.93	2.07	0.11
Living with others who cannot provide sufficient care due to job	177	12	68	1.42	0.78	2.58	0.25	1.32	0.72	2.42	0.36	1.17	0.64	2.15	0.61
Living with another who is receiving long-term care insurance service	110	15	137	1.87	1.08	3.24	0.03	1.89	1.07	3.34	0.03	1.47	0.82	2.64	0.19
Living alone with frequent support from family and friends	198	11	56	1.14	0.61	2.11	0.68	1.09	0.58	2.02	0.79	1.08	0.58	2.01	0.81
Living alone without support from family or friends	22	5	230	6.37	2.60	15.59	<0.01	5.76	2.16	15.36	<0.01	6.29	2.35	16.83	<0.01
Mobility ^d ≥ level 4	4577	182	40												
Living with others who provide care throughout the day	3763	136	36	Reference				Reference					Reference		
Living with others who cannot provide sufficient care due to illness, or infirmity	367	21	57	1.27	0.80	2.04	0.32	1.12	0.69	1.80	0.65	1.07	0.66	1.74	0.77
Living with others who cannot provide sufficient care due to job	154	8	52	1.32	0.64	2.71	0.45	1.38	0.57	2.83	0.38	1.24	0.60	2.55	0.56
Living with another who is receiving long-term care insurance service	90	7	78	0.90	0.41	1.96	0.79	0.82	0.37	1.84	0.63	0.65	0.28	1.47	0.30
Living alone with frequent support from family and friends	183	7	38	0.93	0.43	2.00	0.86	0.85	0.39	1.83	0.67	0.87	0.41	1.88	0.73
Living alone without support from family or friends	20	3	147	4.16	1.32	13.16	0.02	3.93	1.24	12.50	0.02	4.86	1.53	15.40	<0.01
Mobility ^d ≤ level 3	3	252	43	171											
Living with others who provide care throughout the day	125	13	104	Reference				Reference					Reference		
Living with others who cannot provide sufficient care due to illness, or infirmity	68	12	176	2.06	0.89	4.79	0.09	2.38	0.97	5.82	0.06	2.64	1.07	6.51	0.04
Living with others who cannot provide sufficient care due to job	23	4	174	1.97	0.61	6.41	0.26	2.23	0.67	7.46	0.19	2.06	0.61	6.94	0.24
Living with another who is receiving long-term care insurance service	20	8	409	4.98	1.96	12.65	0.00	4.31	1.49	12.43	0.01	4.27	1.48	12.34	0.01
Living alone with frequent support from family and friends	15	4	265	2.66	0.82	8.56	0.10	2.52	0.69	9.17	0.16	2.20	0.61	7.93	0.23
Living alone without support from family or friends	1	2	2000	12.21	2.35	63.33	<0.01	20.04	2.38	168.54	<0.01	15.34	1.77	132.64	0.01

^a Crude death rate per 1000 person-year.

^b Model 1 included age, mobility and medical status.

^c Model 2 included age, mobility, medical status, and use of long-term care insurance service.

^d Level 5, ability of the elder to climb stairs without aid or assistive devices; level 4, cannot climb stairs without aid but can walk on flat surface without aid or assistive devices; level 3, cannot walk on a flat surface without aid, but can move around using assistive devices and perform transfer independently while seated; level 2, cannot either move around or transfer while seated using assistive device or aid from the others, but can sit up and maintain seated position; level 1, cannot either sit up or maintain seated position but can roll over on the bed without aid; and level 0, cannot roll over on a bed while lying without aid.

use of long-term care insurance service. These models included living arrangement, age, level of mobility, medical status, and use of long-term care insurance service as time-dependent variable. Subjects were further divided into two groups before analysis, those with relatively good mobility (mobility level 4 or 5) and less mobility (3 or less). The detailed levels of mobility status are still used for adjustment even in the good mobile and less mobile stratum. Data were analyzed using STATA statistical software, version 9 (Stata Corporation, College Station, Texas).

Results

Table 1 shows characteristics of subjects by year of survey, and Table 2 shows baseline characteristics according to living arrangement group for men and women. Those living with others who were receiving long-term care insurance service were slightly older than the other groups and had a lower level of mobility. Subjects living with others who were receiving long-term care insurance service were more likely to receive long-term care insurance service themselves.

A significant difference in mortality by living arrangement was seen among elderly men (Table 3): mortality was higher among men living with others who cannot provide sufficient care due to illness, or

infirmity; those living with others receiving long-term care insurance care; and those living alone without support from family or friends than among men living with others able to provide care throughout the day (age-adjusted HR=1.52, 95%CI: 1.03–2.24; age-adjusted HR=1.87, 95%CI: 1.08–3.24; and age-adjusted HR=6.37, 95%CI: 2.60–15.59, respectively). These differences were heightened when analysis was limited to men with less mobility. In contrast, living arrangement was not associated with survival among elderly women (Table 4).

Among men with less mobility, mortality was higher among those living with others who cannot provide sufficient care due to illness or infirmity; those living with others receiving long-term care insurance care; and those living alone without support from family or friends than among men living with others able to provide care throughout the day (age-adjusted HR=2.06, 95%CI: 0.89–4.79; age-adjusted HR=4.98, 95%CI: 1.96–12.65; and age-adjusted HR=12.21, 95%CI: 2.35–63.33, respectively).

Of note, no association with mortality was seen for men living alone with frequent support from family and friends (age-adjusted HR=1.14, 95%CI: 0.61–2.11). In addition, when data for the two groups living alone were combined, age-adjusted HR of living alone was not statistically significant (age-adjusted HR=1.53, 95%CI: 0.91–2.59, $p=0.108$; not shown in the table). When analysis was limited to men

Table 4
Hazard ratios of living arrangement for mortality among women (Yukuhashi City, Japan, 2002–2007)

	Person year	Number of deaths	Death rate ^a	Age-adjusted			Model 1 ^b			Model 2 ^c					
				HR	95% CI	p	HR	95% CI	p	HR	95% CI	p			
Total	6810	156	23												
Living with others who provide care throughout the day	3553	77	22	Reference			Reference				Reference				
Living with others who cannot provide sufficient care due to illness, or infirmity	1040	22	21	1.25	0.78	2.03	0.35	1.14	0.70	1.85	0.60	1.19	0.73	1.94	0.48
Living with others who cannot provide sufficient care due to job	777	19	24	0.79	0.47	1.33	0.38	0.84	0.50	1.44	0.53	0.52	0.54	1.57	0.76
Living with another who is receiving long-term care insurance service	223	8	36	1.09	0.52	2.27	0.82	0.69	0.30	1.62	0.40	0.69	0.30	1.59	0.38
Living alone with frequent support from family and friends	1152	29	25	0.93	0.60	1.42	0.73	0.96	0.62	1.49	0.86	0.93	0.60	1.45	0.75
Living alone without support from family or friends	64	1	16	0.72	0.10	5.21	0.75	0.70	0.10	5.08	0.73	0.92	0.13	6.71	0.94
Mobility ^d level 4	6367	117	18												
Living with others who provide care throughout the day	3387	59	17	Reference				Reference				Reference			
Living with others who cannot provide sufficient care due to illness, or infirmity	972	14	14	1.18	0.65	2.14	0.59	1.22	0.67	2.23	0.52	1.26	0.69	2.30	0.46
Living with others who cannot provide sufficient care due to job	691	16	23	0.96	0.54	1.70	0.88	1.01	0.57	1.80	0.98	1.21	0.68	2.18	0.52
Living with another who is receiving long-term care insurance service	201	6	30	1.46	0.63	3.39	0.38	1.31	0.54	3.19	0.55	1.07	0.43	2.65	0.89
Living alone with frequent support from family and friends	1060	22	21	0.92	0.56	1.51	0.75	0.96	0.57	1.62	0.89	0.93	0.55	1.58	0.79
Living alone without support from family or friends	56	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Mobility ^d level 3	442	39	88												
Living with others who provide care throughout the day	166	18	108	Reference				Reference				Reference			
Living with others who cannot provide sufficient care due to illness, or infirmity	68	8	118	1.70	0.71	4.11	0.24	1.64	0.67	4.00	0.28	1.64	0.67	4.01	0.28
Living with others who cannot provide sufficient care due to job	86	3	35	0.35	0.10	1.20	0.10	0.38	0.08	1.69	0.20	0.38	0.08	1.69	0.20
Living with another who is receiving long-term care insurance service	22	2	90	0.57	0.12	2.59	0.46	0.48	0.09	2.68	0.40	0.47	0.08	2.68	0.40
Living alone with frequent support from family and friends	92	7	76	0.94	0.38	2.34	0.90	1.11	0.44	2.80	0.83	1.11	0.44	2.81	0.83
Living alone without support from family or friends	8	1	123	1.59	0.21	12.27	0.66	2.53	0.24	27.12	0.44	2.58	0.24	28.29	0.44

^a Crude death rate per 1000 person-year.

^b Model 1 included age, mobility and medical status.

^c Model 2 included age, mobility, medical status, and use of long-term care insurance service.

^d Level 5, ability of the elder to climb stairs without aid or assistive devices; level 4, cannot climb stairs without aid but can walk on flat surface without aid or assistive devices; level 3, cannot walk on a flat surface without aid, but can move around using assistive devices and perform transfer independently while seated; level 2, cannot either move around or transfer while seated using assistive device or aid from the others, but can sit up and maintain seated position; level 1, cannot either sit up or maintain seated position but can roll over on the bed without aid; and level 0, cannot roll over on a bed while lying without aid.