

CHANGES IN FUNCTIONAL CAPACITY IN OLDER ADULTS LIVING ALONE:

A THREE-YEAR LONGITUDINAL STUDY IN A RURAL AREA OF JAPAN

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Objective The purposes of this research were to clarify three-year changes in functional capacity and to investigate related physical health, psychological/mental health, and social health factors in older adults living alone in a rural area of Japan.

Methods Home visit interviews were conducted in 2000 (the baseline survey: n = 128) and in 2003 (the follow-up survey: n = 101) with older adults living alone in a town in Ishikawa prefecture. Seventy nine subjects were analyzed using logistic regression analysis at the follow-up survey.

Results Of these 79 subjects, 40 persons had scores for functional capacity decreased by one or more points, the "Lowered" group (50.6%), while 27 persons were "Unchanged" (34.2%), and 12 persons were "Improved" (15.2%). Factors at the baseline survey were compared between the "Lowered" group and the "Unchanged/Improved" group. Significant factors that caused a decreased functional capacity were age (75 years old and over), no participation in social activities, and contact with friends/neighbors over the phone less than once a week.

Conclusion This research has shown that participation in social activities and contact with friends/neighbors maintain a higher functional capacity in older adults living alone.

Key words : aged, functional capacity, living alone, longitudinal study, quality of life

I. Introduction

Major changes in living arrangements have occurred in Japan, owing to an increase in the number of older people and a decrease in the birthrate. The number of nuclear families is increasing and the number of three-generational families is decreasing and consequently the households with only a married couple or a single person in which the older adult is the only family member are expected to keep increasing in number. The proportion of households of older adults living alone is increasing, for example, 8.5% in 1980, 11.2% in 1990, and 14.2% in 2002, respectively. This tendency is continuing and according to estimated figures, the total amount of households of older adults living alone will total 5.3

million in 2020¹⁾.

As the estimated number of older adults grows, a socially independent lifestyle is expected for the old adults not only in their basic activities of daily living (BADL), but also in their higher-level activities of daily living of competence²⁾. For a more positive life, the higher-level competences of "Instrumental Self-maintenance", "Intellectual Activity", and "Social Role" must be maintained, these generally being defined as "functional capacity"^{3~7)}. Koyano et al.⁸⁾ reported that approximately 75% of older adults living alone in a community have an independent functional capacity. Another result was obtained approximately 90% of older adults living alone also have physical independence⁹⁾. However, it is more difficult to keep a healthy lifestyle for older adults living alone than those living with others¹⁰⁾. When deterioration in their status occurs, they need various support from separated families, friends, neighbors, and medical, health and social services. In some cases, their living places or conditions will be largely changed after rehabilitation or treatment¹¹⁾. In other words, older adults living alone have more potential problems in their health and living conditions compared with those living with others.

Several cross-sectional studies have described

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the characteristics of older adults living alone when compared with those living with others. No clearly specific characteristics were evident in some of the available reports^{12,13}. However, in one investigation a difference between older adults living alone and older adults living with their families was found regarding social support from neighbors in the community¹⁴ and the authors suggested more help was needed to provide older adults living alone with a point of contact in case of emergency. In longitudinal studies, with death assumed to be the outcome, no difference between older adults living alone or with others was apparent^{15,16}. However, when examining physical health, psychological/mental health, and social health factors as outcomes, older adults living alone did show differences¹⁷. This was also confirmed in a four-year follow-up survey for female older adults living alone, namely, that contact with friends and relatives significantly prevents lowering of mental health scores¹⁸.

In Japan, several cross-sectional studies have been performed with older adults living alone as the focus group since the 1990's^{8,10,19,20}. Single households of older adults have priority eligibility for entry into special nursing homes for the aged²¹. However, no longitudinal study focusing on older adults living alone has yet been documented to our knowledge in Japan. Only a few preventive services are in place by which older adults living alone are protected from becoming homebound or bed-ridden or physically handicapped. The purpose of the present 3-year

longitudinal study was to clarify changes in functional capacity and to investigate related changes physical health, psychological/mental health, and social health factors.

II. Methods

Data collection

The baseline survey was conducted from September to November in 2000, and the follow-up survey from August to October in 2003. Older adults were identified in single households from the Resident Registries. The number of older adults living alone over 65 years was 245 in a town of Ishikawa prefecture in 2000. Figure 1 shows the study protocol. First, 84 subjects in hospital or facilities for the aged were excluded from the 245. Second, from detailed information provided by welfare commissioners in each district, an additional 14 subjects were excluded as living with others, 13 as in hospitals or facilities for aged, 8 because they had died and 2 because of transfer, while 4 subjects who were confirmed as living alone were added to the subject list. One hundred twenty eight subjects were thus eligible for the baseline survey in 2000. From the results of 6 subjects with others, 4 subjects in hospital or facilities, one person who was transferred, 11 subjects who were absent and 5 subjects who refused to be interviewed were excluded. The follow-up survey was conducted for 101 subjects in 2003. Eighty subjects remained living alone, and only one person refused in the follow-up survey. Data for seventy nine subjects were therefore analyzed by multiple logistic regression analysis.

Questionnaires were collected by home visiting interviewers, who were public health nurses, registered nurses, and certified care workers in 2000 and public health nurses in 2003, and the average time for an interview was 45 minutes. Details of the baseline survey process were described in a previous research report⁹.

Measures

1) Dependent variable.

Functional capacity was measured using the Tokyo Metropolitan Institute of Gerontology Index of Competence (TMIG-Index of competence) which consists of thirteen items: five items of "Instrumental Self-maintenance", four items of "Intellectual Activity", and four items of "Social Role". The response to each item was designed as 'yes (able to do)' or 'no (unable)' and scored as 1 for 'yes' and 0 for 'no'. Full marks for the total of 13 items thus equalled 13 points^{22,23}. A higher score indicates a higher competence of functional status for older adults.

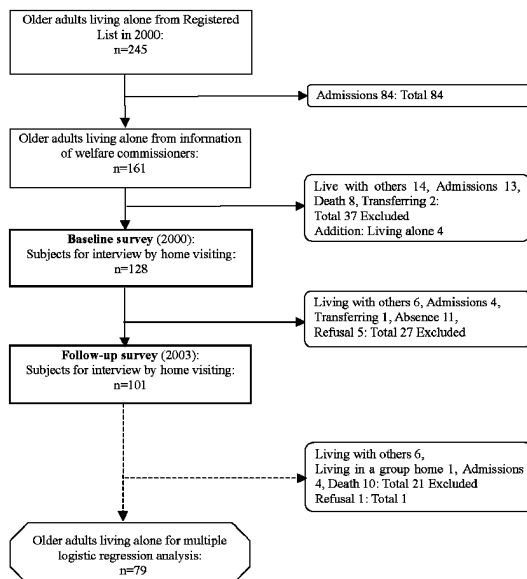


Figure 1. Study Protocol

2) Independent variables.

Independent variables were arranged according to the three factors of physical health status, psychological/mental health status, and social health status. The following include the physical factors: admission to a hospital within one year preceding the baseline survey (yes or no), current medical treatments (yes or no), self-reported diseases currently being treated medically, criteria for evaluating the degree of independence of disabled elderly persons in performing activities of daily living²⁴⁾, screening levels of long-term care required by the Long-term Care Insurance System, basic activities of daily living (BADL), visual impairment, hearing impairment, cognitive impairment, physical performance by the motor fitness scale and self-rated health.

The basic activities of daily living were measured using the Barthel index developed by Mahoney et al.²⁵⁾. Visual impairment was assessed into three categories: able to read a newspaper, able to recognize someone one meter ahead, and almost unable to see. Hearing impairment was also similarly assessed: able to hear normally, able to hear when someone speaks in a loud voice, and almost unable to hear and cognitive impairment was assessed: none or no inconvenience in daily life, slight inconvenience, and serious inconvenience. Physical performance was measured using the Motor Fitness Scale (MFS)²⁶⁾. Self-rated health was assessed in 4 categories (good, fair, poor, and very poor) by asking: "How would you rate your present health?^{27,28)}"

The following include psychological/mental health factors: depression status, self-efficacy in activities of daily living, and feeling that life is worth living. Depressive status was measured by the short version of the Geriatric Depression Scale (GDS)^{29~31)}. Yatomi³²⁾ reported this to have reliability and validity for older adults in Japan. A score of 5 or greater shows a tendency for a depressive condition. The total GDS score included missing values that were estimated based on the answer tendency to the items effectively answered. For 10 subjects who answered 1/2 or more (over 8-items) of the total number of items, the following calculation method was used to estimate scores for incorporation of analysis: multiplying the total score by the reciprocal of the number of answered items over the number of total items¹⁵⁾: for an examinee who answered 8 items with a total point value of 3, the estimated score was $3 \times 15/8 = 5.6$ points³³⁾. Self efficacy in activities of daily living was measured using six items of a modification of the Falls Efficacy Scale (FES)²³⁾, developed by Tinetti et al.³⁴⁾.

The following were the social health factors: having a job, participation in social activities, fre-

quency of contact with family members face-to-face or over the phone, and frequency of contact with friends/neighbors face-to-face or over the phone. The frequency of participation in social activities and contact with family members or friends/neighbors face-to-face or over the phone were divided into five categories; (1) two or more times a week, (2) once a week, (3) 1-2 times a month, (4) a few times a year, and (5) none.

Statistical analysis

The statistical data were analyzed using the SPSS statistical package software version 10.0 J for Windows. Comparisons among categorical variables were made using the chi-square test and the Fisher's exact test (when the expectation value was less than 5 per cell), for ordered variables using the Mann-Whitney U test or Kruskal-Wallis' H test, and for continuous variables with the Student t test, the One-way ANOVA. We divided subjects into three groups; "Improved", "Unchanged" and "Lowered" demonstrating increase, maintenance and decrease of the functional capacity score from 2000 to 2003. "Lowered" was then compared with "Unchanged/Improved" combined, because maintenance of competence in functional status is thought to be successful aging³⁵⁾. Multiple logistic regression analysis was used to examine the changes in functional capacity. Odds ratios were adjusted for the functional capacity score at the baseline survey according to forced entry. A significant difference was calculated with a two-sided p value less than 0.05.

Ethical approvals

All participants provided verbal informed consent. Prior to the home visit interviews, all participants received the survey documents by mail and received information in advance on the purpose of the survey, including the request for an interview at home, and a visiting schedule. After sending the information, a phone call was made if possible and permission was obtained for a visit. The public health nurses visited older adults at home and explained the purpose of this survey once again. They then made the interview using the questionnaire if consent had been given. In addition, prior to approaching the subjects, we explained the purpose of this survey to the district welfare department in order to obtain permission from the local authorities. After this explanation, public health nurses asked welfare commissioners in districts to explain the purpose of the survey at meetings to be held in their districts.

III. Results

Changes in functional capacity

The subjects were 81 females (80.2%) and 20

Table 1-1. Characteristics of older adults living alone by gender at the baseline survey

Contents		Males (n = 20)		Females (n = 81)		P-value	
		mean \pm SD, n	%	mean \pm SD, n	%		
Sociodemographic factors							
Age		75.6 \pm 7.7		75.9 \pm 6.7		0.827	
\geq 75		10	50.0	46	56.8	0.584	
Years living alone ^a		10.1 \pm 11.1		9.2 \pm 9.1		0.979	
Functional capacity							
TMIG Index of competence		12.1 \pm 1.6		10.9 \pm 3.2		0.190	
Physical health factors							
Admission to a hospital within one year preceding the baseline survey ^b		3	15.8	11	13.6	0.726	
Current medical treatments		15	75.0	67	82.7	0.523	
Self-reported diseases							
Hypertension		6	37.5	30	47.6	0.468	
Heart disease		2	12.5	13	20.6	0.723	
Gastrointestinal disease		2	12.5	12	19.0	0.723	
Eye disease		1	6.3	8	12.7	0.334	
Osteoporosis		0	0.0	9	14.3	1.000	
Diabetes		2	12.5	5	7.9	0.191	
Hyperlipidemia		2	12.5	5	7.9	0.677	
Articular rheumatism		0	0.0	7	11.1	1.000	
Lumbalgia		1	6.3	5	7.9	0.625	
Respiratory disease		1	6.3	3	4.8	0.625	
Stroke		0	0.0	1	1.6	1.000	
Liver disease		0	0.0	1	1.6	1.000	
Other diseases		1	6.3	16	25.4	0.170	
Degree of independence		Independence		64		79.0	0.350 [†]
		Rank J		12		14.8	
		Rank A		4		4.9	
		Rank B		1		1.2	
		Rank C		0		0.0	
Screening levels of long-term care insurance		Support required		9		11.1	1.000
		Care level 1		3		3.7	
		Care level 2		1		1.2	
		Care level 3		1		1.2	
Basic activities of daily living		99.8 \pm 1.1		98.0 \pm 10.9		0.677	
Visual impairment		1	5.0	7	8.6	1.000	
Hearing impairment		6	30.0	16	19.8	0.367	
Cognitive impairment		1	5.0	12	14.8	0.455	
Physical performance		11.6 \pm 3.4		7.9 \pm 4.0		0.000	
Self-rated health ^c		good		10		12.7	0.728 [‡]
		fair		45		57.0	
		poor		18		22.8	
		very poor		6		7.6	

Missing: a = 99, b = 100, c = 98, d = 89, e = 96

 χ^2 test, Fisher exact test, t test, Mann-Whitney U test[†] Independence vs. Rank J, A, B.[‡] Very good and good vs. poor and very poor.

Table 1-2. Characteristics of older adults living alone by gender at the baseline survey

Contents		Males (n=20)		Females (n=81)		P-value
		mean ± SD, n	%	mean ± SD, n	%	
Psychological/mental health factors						
Depressive status ^d		2.7 ± 2.7		3.5 ± 3.1		0.357
Depressive condition		2	12.5	19	26.0	0.340
Self-efficacy in activities of daily living ^e		22.1 ± 2.8		19.9 ± 3.9		0.021
Feeling life to be well worth living	yes	17	94.4	65	83.3	0.457
Social health factors						
Having a job	yes	8	40.0	16	19.8	0.078
Participation in social activities ^b	yes	12	63.2	46	56.8	0.613
	none	7	36.8	35	43.2	
Frequency of contact with family members face-to-face ^b	≥ 1/a week	8	42.1	37	45.7	0.778
	< 1/a week	11	57.9	44	54.3	
Frequency of contact with family members over the phone ^c	≥ 1/a week	10	52.6	42	53.2	0.967
	< 1/a week	9	47.4	37	46.8	
Frequency of contact with friends/neighbors face-to-face ^a	≥ 1/a week	14	73.7	73	87.9	0.050
	< 1/a week	5	26.3	7	12.1	
Frequency of contact with friends/neighbors over the phone	≥ 1/a week	8	44.4	33	42.3	0.869
	< 1/a week	10	55.6	45	57.7	

Missing: a = 99, b = 100, c = 98, d = 89, e = 96

χ² test, Fisher exact test, t test, Mann-Whitney U test

males (19.8%), mean age 75.9 years old (standard deviation 6.8), and age range was from 65 to 97 years at the baseline survey. Table 1-1 and Table 1-2 show characteristics of older adults living alone by gender.

In the baseline survey, 53 (67.1%) received full scores, but in the follow-up survey, this was the case for only 28 (35.4%). The score of functional capacity in 2003 was significantly correlated with the score in 2000 ($R^2 = .24$, $P < .001$). The score of 40 subjects (50.6%) had decreased, and the average number of points for the functional capacity score significantly decreased from 11.6 ± 2.4 to 10.4 ± 3.2 ($P = .001$) in 2000 and 2003. The average number of points for "Instrumental Self-maintenance" and "Intellectual Activity" significantly decreased from 4.8 ± 0.6 to 4.3 ± 1.3 ($P = .001$) and from 3.6 ± 1.1 to 3.2 ± 1.2 ($P = .001$). The average number of points for "Social Role" decreased from 3.2 ± 1.4 to 2.9 ± 1.4 ($P = .073$). Table 2 shows the average number of points for the functional capacity score by age and gender in 2000 and 2003. The average total, "Instrumental Self-maintenance" and "Intellectual Activity" scores significantly decreased in subjects aged 75 years and over. Total and three subscale scores were significantly decreased in female subjects. The rate for subjects who had scores of ten points or less increased to 36.7%.

Prognoses, which were categorized into 3

groups: living alone (80 persons), living with others or living in a group home (7 persons), and deaths (10 persons) at the follow-up survey were compared with age, gender and functional capacity scores at the baseline survey (Table 3).

The factors related to changes in functional capacity were examined in 79 persons, excluding the one refusal among the 80 persons living alone, divided into "Lowered" 40 (50.6%), "Unchanged" 27 (34.2%), and "Improved" 12 (15.2%) groups. Subjects who had 13 points of functional capacity score in 2000 were 27 (67.5%) in the "Lowered" and 25 (92.6%) in the "Unchanged". Subjects who had from 2 to 9 points of functional capacity score in 2000 were 6 (15.0%) in the "Lowered", 2 (7.4%) in the "Unchanged" and 8 (66.7%) in the "Improved". The average functional capacity score significantly decreased from 11.7 ± 2.5 to 8.6 ± 3.5 in the "Lowered" ($P = .000$) and significantly increased from 11.5 ± 2.4 to 12.3 ± 1.2 in the "Unchanged/Improved" ($P = .001$) in 2000 and 2003. *Relationship among functional capacity and physical health, psychological/mental health and social health factors*

In order to examine functional capacity and related factors for older adults living alone, factors at 2000 were compared between the "Lowered" group and the "Unchanged/Improved" group (Table 4-1 and Table 4-2). The "Lowered" group showed significantly higher percentages of hearing impairment,

Table 2. Changes in functional capacity score by age and gender in 2000 and 2003

		2000		2003		P-value	
		mean ± SD					
≤ 74 (n = 36)	Total score	12.4 ± 2.0		12.0 ± 1.2		0.169	
	Instrumental self-maintenance	4.9 ± 0.2		4.9 ± 0.4		0.711	
	Intellectual activity	3.7 ± 1.1		3.5 ± 0.8		0.201	
	Social role	3.8 ± 0.9		3.5 ± 0.7		0.244	
≥ 75 (n = 43)	Total score	11.0 ± 2.6		9.1 ± 3.8		0.002	
	Instrumental self-maintenance	4.7 ± 0.7		3.9 ± 1.5		0.000	
	Intellectual activity	3.5 ± 1.0		2.9 ± 1.4		0.002	
	Social role	2.8 ± 1.5		2.4 ± 1.6		0.162	
Males (n = 16)	Total score	12.1 ± 1.7		11.9 ± 1.7		0.606	
	Instrumental self-maintenance	4.8 ± 0.7		4.6 ± 1.1		0.188	
	Intellectual activity	3.9 ± 0.3		3.8 ± 0.4		0.580	
	Social role	3.5 ± 1.0		3.6 ± 0.8		0.843	
Females (n = 63)	Total score	11.5 ± 2.6		10.0 ± 3.4		0.001	
	Instrumental self-maintenance	4.8 ± 0.5		4.3 ± 1.3		0.001	
	Intellectual activity	3.5 ± 1.2		3.0 ± 1.3		0.001	
	Social role	3.1 ± 1.4		2.7 ± 1.5		0.047	
Males	≤ 74 (n = 8)	Total score	13.0 ± 0.0		12.3 ± 1.2		0.111
		Instrumental self-maintenance	5.0 ± 0.0		5.0 ± 0.0		—
		Intellectual activity	4.0 ± 0.0		3.8 ± 0.5		0.170
		Social role	4.0 ± 0.0		3.5 ± 1.1		0.227
	≥ 75 (n = 8)	Total score	11.3 ± 2.1		11.6 ± 2.1		0.504
		Instrumental self-maintenance	4.5 ± 0.9		4.1 ± 1.5		0.197
		Intellectual activity	3.8 ± 0.5		3.9 ± 0.4		0.351
		Social role	3.0 ± 1.2		3.6 ± 0.5		0.180
Females	≤ 74 (n = 28)	Total score	12.2 ± 2.2		11.9 ± 1.3		0.404
		Instrumental self-maintenance	4.9 ± 0.3		4.9 ± 0.4		0.713
		Intellectual activity	3.6 ± 1.3		3.5 ± 0.9		0.415
		Social role	3.7 ± 1.0		3.5 ± 0.7		0.515
	≥ 75 (n = 35)	Total score	10.9 ± 2.7		8.5 ± 3.8		0.001
		Instrumental self-maintenance	4.7 ± 0.7		3.8 ± 1.6		0.001
		Intellectual activity	3.5 ± 1.1		2.7 ± 1.5		0.001
		Social role	2.7 ± 1.6		2.1 ± 1.6		0.060
Total score ≤ 10 point ¹⁾			20 (25.3%)		29 (36.7%)		

1) the number of subjects (%)

paired t-test

Table 3. Relationship between situation in 2003 and age, gender and functional capacity in 2000

	Living alone (n = 80)		Living with others/group home (n = 7)		Death (n = 10)		P-value
	mean ± SD, n	%	mean ± SD, n	%	mean ± SD, n	%	
Age	75.3 ± 6.3		79.0 ± 5.9		78.3 ± 10.8		0.190
Female	63	78.8	6	85.7	9	90.0	0.801
Functional capacity	11.6 ± 2.4		9.0 ± 4.8		9.7 ± 4.6		0.107

Kruskal-Wallis H test, χ^2 test, One-way ANOVA

Table 4-1. Relationship between changes in functional capacity and other factors at the baseline survey

Contents		Lowered (n=40)		Unchanged/improved (n=39)		P-value
		mean ± SD, n	%	mean ± SD, n	%	
Sociodemographic factors						
Age	65-74	14	38.9	22	61.1	0.056
	≥ 75	26	60.5	17	39.5	
Gender	male	6	37.5	10	62.5	0.239
	female	34	54.0	29	46.0	
Years in living alone ^a		10.2 ± 8.8		9.4 ± 10.6		0.712
Functional capacity						
TMIG Index of competence		11.7 ± 2.5		11.5 ± 2.4		0.768
Physical health factors						
Admission to a hospital within one year preceding baseline survey ^b	yes	5	55.6	4	44.4	1.000
	no	35	50.7	34	49.3	
Current medical treatments	yes	31	47.7	34	52.3	0.260
	no	9	64.3	5	35.7	
Self-reported diseases						
Hypertension	yes	18	50.0	18	50.0	0.918
	no	22	51.2	21	48.8	
Heart disease	yes	8	53.3	7	46.7	0.816
	no	32	50.0	32	50.0	
Gastrointestinal disease	yes	7	50.0	7	50.0	0.958
	no	33	50.8	32	49.2	
Eye disease	yes	4	44.4	5	55.6	0.737
	no	36	51.4	34	48.6	
Osteoporosis	yes	3	33.3	6	66.7	0.311
	on	37	52.9	33	47.1	
Diabetes	yes	5	71.4	2	28.6	0.432
	no	35	48.6	37	51.4	
Hyperlipidemia	yes	1	14.3	6	85.7	0.057
	no	39	54.2	33	45.8	
Articular rheumatism	yes	4	57.1	3	42.9	1.000
	no	36	50.0	36	50.0	
Lumbalgia	yes	4	66.7	2	33.3	0.675
	no	36	49.3	37	50.7	
Respiratory disease	yes	2	50.0	2	50.0	1.000
	no	38	50.7	37	49.3	
Stroke	yes	0	0.0	1	100.0	0.494
	no	40	51.3	38	48.7	
Liver disease	yes	0	0.0	1	100.0	0.494
	no	40	51.3	38	48.7	
Other diseases	yes	7	41.2	10	58.8	0.379
	no	33	53.2	29	46.8	
Degree of independence	Independence	34	50.7	33	49.3	1.000
	Rank J	6	54.5	5	45.5	
	Rank A	0	0.0	1	100.0	
Basic activities of daily living		99.8 ± 1.6		99.7 ± 1.1		0.983
Visual impairment	yes	3	60.0	2	40.0	1.000
	no	37	50.0	37	50.0	
Hearing impairment	yes	12	75.0	4	25.0	0.029
	no	28	44.4	35	55.6	
Cognitive impairment	yes	3	50.0	3	50.0	1.000
	no	37	50.7	36	49.3	
Physical performance		8.7 ± 3.6		9.4 ± 4.0		0.425
Self-rated health ^a	good	31	53.4	27	46.6	0.280
	poor	7	38.9	11	61.1	

Missing: a = 77, b = 78, c = 71

 χ^2 test, Fisher exact test, t test, Mann-Whitney U test

Table 4-2. Relationship between changes in functional capacity and other factors at the baseline survey

Contents		Lowered (n = 40)		Unchanged/improved (n = 39)		P-value
		mean ± SD, n	%	mean ± SD, n	%	
Psychological/mental health factors						
Depressive status ^c		2.5 ± 1.8		3.0 ± 3.0		0.397
Depression condition	yes	4	33.3	8	66.7	0.268
	no	30	50.8	29	49.2	
Self-efficacy to activities of daily life ^a		20.5 ± 3.1		21.2 ± 3.3		0.285
Feeling to be well worth living	yes	36	51.4	34	48.6	0.665
	no	3	42.9	4	57.1	
Social health factors						
Having a job	yes	8	42.1	11	57.9	0.394
	no	32	53.3	4	57.1	
Participation in social activities ^b	yes	18	39.1	28	60.9	0.021
	none	21	65.6	11	34.4	
Frequency of contact with family members face-to-face ^b	≥ 1/a week	21	60.0	14	40.0	0.111
	< 1/a week	18	41.9	25	58.1	
Frequency of contact with family members over the phone ^b	≥ 1/a week	20	48.8	21	51.2	0.821
	< 1/a week	19	51.4	18	48.6	
Frequency of contact with friends/neighbors face-to-face ^b	≥ 1/a week	33	46.5	38	53.5	0.108
	< 1/a week	6	85.7	1	14.3	
Frequency of contact with friends/neighbors over the phone ^b	≥ 1/a week	10	30.3	23	69.7	0.003
	< 1/a week	29	64.4	16	35.6	

Missing: a = 77, b = 78, c = 71

χ² test, Fisher exact test, t test, Mann-Whitney U test

Table 5. Odds ratios in the prediction of changes in functional capacity among older adults living alone: Multiple logistic regression analysis¹⁾

Factors	β	P-value	odds ratio	95%CI
Age ²⁾	1.229	0.044	3.419	1.033-11.317
Gender ³⁾	1.135	0.109	3.113	0.778-12.459
Hearing impairment ⁴⁾	1.071	0.166	2.918	0.641-13.275
Participation in social activities ⁵⁾	1.275	0.028	3.580	1.144-11.205
Contact with friends/neighbors over the phone ⁶⁾	1.343	0.017	3.831	1.275-11.512

- 1) Odds ratio were calculated as the relative risk of changes in functional capacity associated with factors and were adjusted for functional capacity score at the baseline survey. Forced entry: All variables are entered in a single step.
- 2) Age was coded as 0 = 65-74, 1 = ≥ 75. Odds ratio was the relative risk of lowered functional capacity associated with ≥ 75.
- 3) Gender was coded as 0 = male, 1 = female.
- 4) Hearing impairment was coded as 0 = no, 1 = yes.
- 5) Participation in social activities was coded as 0 = yes, 1 = none. The odds ratio was the relative risk of lowered functional capacity associated with none.
- 6) Contact with friends/neighbors over the phone was coded as 0 = ≥ 1/a week, 1 = < 1/a week. The odds ratio was the relative risk of lowered functional capacity associated with < 1/a week.

no participation in social activities, and low frequency of contact with friends/neighbors over the phone compared with those in the “Unchanged/Improved” group. Moreover, “Lowered” showed a significantly high percentage of older adults aged 75

years and over when compared with “Unchanged/Improved”.

Based on the results of the analysis using two variates (“Lowered” and “Unchanged/Improved”), multiple logistic regression analysis was performed

by selecting the variables with a significant difference and by adjusting the scores obtained for functional capacity at the baseline. The results showed a significant difference as to age, participation in social activities, and frequency of contact with friends/neighbors over the phone (Table 5). Significant factors that caused decreased functional capacity were age (75 years and over), no participation in social activities, and contact with friends/neighbors over the phone less than once a week.

IV. Discussion

Our research established that finding older adults who were actually living alone in a community is relatively difficult. Subjects of our 3-year longitudinal research were selected from information given by welfare commissioners, and screening was performed by home visits. In this research, 6 persons who were thought to be eligible as subjects at the baseline survey in fact lived with others. Koyano⁸⁾ reported, among single households of older adults registered on records, approximately only 60% of them to be actually living alone in a community. Changes in living arrangements have been reported to influence health status, and future investigation will be needed regarding the transfer of households from older adults living with others to older adults living alone¹¹⁾.

In the present study conducted among older adults living alone, the rate for subjects who decreased 1 point or more in the functional capacity score as compared with the score of the baseline survey was 50.6%. Haga³⁶⁾ estimated that the decreased score in functional capacity among community-dwelling older adults was one point in five years, and 0.2 points in one year. In our results, the average scores of total subjects, males and females decreased by 1.2 points, by 0.2 points and by 1.5 points in three years respectively. In addition, the rate of subjects who had scores of ten points or less increased to 36.7%. They have to be considered as subjects who need preventive services for maintenance of their functional capacity. We classified older adults living alone by group according to the changes in their scores (1 point or more) given in the baseline and follow-up surveys, and termed their functional capacity as "Lowered", or "Unchanged/Improved". For application of individual evaluation among community-dwelling older adults, a recent study used test-retest methods with a month interval, and this indicated that change of one point in total scores may be within the range of measurement error³⁷⁾. Therefore, it is necessary to consider changes of two points or more in case of short term

observations. However, Koyano et al.⁵⁾ indicated that a 1 point change in scores was associated with relative risk factors of mortality in their 1-year longitudinal study. We therefore conclude that our group classification was appropriate for analysis because our research was designed for a 3-year longitudinal study.

For community-dwelling older adults, a number of authors have examined functional capacity by classifying into groups depending on their degree of independence; for example, independent older adults, frail older adults, and housebound older adults^{3,6,22,38,39)}. In longitudinal studies, age, mobility, self-rated health, and contact with friends were clarified as factors relating to functional capacity in community-dwelling older adults^{3,23,36)}. Among these studies, only one report indicated that functional capacity decreased when older adults had few associations with friends³⁶⁾. In our research, the frequency of contact with friends/neighbors over the phone was significantly related to functional capacity, but the frequency of contact with friends/neighbors by face-to-face communication was not. Fees et al.⁴⁰⁾ reported that the frequency of telephone contact, and age, but not the frequency of face-to-face contact with others affects perceived loneliness. Gueldner et al.⁴¹⁾ showed in their findings that the telephone as an intervention decreased loneliness and increased feelings of connectedness among mentally alert nursing home residents. There have hitherto been no data showing associations between lack of participation of social activities and decrease in functional capacity among community-dwelling older adults. However, our study suggested that lack of participation of social activities could predict decline in functional capacity among older adults living alone. The role of social activities among older adults living alone has to be examined in further studies. In addition, sensory impairment is an important factor in maintaining an independent lifestyle for older adults^{42,43)}, although multiple logistic regression analysis indicated no significant difference in hearing impairment for changes in functional capacity in our study. It is necessary to carry out more research because participating in social activities and having contact with others are naturally influenced by hearing impairment.

The limitations of our study are as follows: representativeness of subjects, validity of selecting variables. First, the number of subjects was limited and in only one locality. Because 101 people including the number of deaths were followed, our study population was small, although the total number of older adults living alone in one region was targeted. It is not clear whether the results of this research can

also be applied socially and culturally to urban areas or not because only one municipality of a province was studied. Second, factors not examined in this study such as smoking, serum albumin level, grip strength, time to stand with one leg, systolic blood pressure, alcoholic consumption are also related to changes in functional capacity^{3,23,36)} and need to be taken into account into future investigations. Furthermore, we found that it is extremely difficult to perform measurement of strength tests or blood examinations of all members when targeting older adults living alone in a community.

A uniform view of older adults has been reviewed, and support corresponding to the actual diverse lifestyle of older adults has begun to be examined in recent years⁴⁴⁾. Problems of older adults are caused not only with reference to aging and physical independence, but also through living arrangements and social activities, and the diversified lifestyles of older adults need to be examined. It is also important to a policy-making strategy that offers suitable support for older adults living alone. This research has shown participation in social activities and contact with friends/neighbors to maintain a higher functional capacity in older adults living alone.

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