Association between falls and depressive symptoms or visual impairment among Japanese young-old adults

Reiji Kojima,[1, 2] Shigekazu Ukawa,[1] Masahiko Ando,[3] Takashi Kawamura,[4] Kenji Wakai,[5] Kazuyo Tsushita[6] and Akiko Tamakoshi[1]

[1] Department of Public Health, Hokkaido University Graduate School of Medicine, Hokkaido, Japan

[2] Department of Pediatrics, Japan Ground Self Defense Forces Sapporo Hospital, Hokkaido, Japan.

[3] Center for Advanced Medicine and Clinical Research, Nagoya University Hospital, Aichi, Japan

[4] Kyoto University Health Service, Kyoto, Japan

[5] Department of Preventive Medicine, Nagoya University Graduate School of Medicine, Aichi, Japan

[6] Comprehensive Health Science Center, Aichi Health Promotion Foundation, Aichi, Japan

Correspondence: Professor Akiko Tamakoshi, MD, PhD, Department of Public Health, Hokkaido University Graduate School of Medicine, N15 W7, Kita-ku, Sapporo Hokkaido, 060-0812, Japan

Telephone; +81 11 706 5068, Fax; +81 11 706 7805 Email: tamaa@med.hokudai.ac.jp

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Abstract

Aim: To investigate the association between falls and self-reported depressive symptoms or visual impairment among young-old adults.

Methods: A total of 1,904 participants (986 males and 918 females) aged 64 years from the New Integrated Suburban Seniority Investigation Project from 1996 to 2005, an age-specific cohort study in Nisshin, Japan. Depressive symptoms were evaluated using the Geriatric Depression Scale. Visual impairment was assessed using a self-administered questionnaire. The outcome variable was self-reported injurious falls at the age of 70. Multivariate odds ratios (ORs) and 95% confidence intervals (CIs) of depressive symptoms and visual impairment for the incidence of falls were calculated using logistic regression models and adjusted for possible confounding factors.

Results: Overall, 77 (7.8%) males and 126 (13.7%) females reported falls within the last 1 year at age 70. Among females, depressive symptoms and visual impairment were significantly associated with falls after adjusting for potential confounders (OR: 1.70, 95% CI: 1.09–2.62; OR: 2.34, 95% CI: 1.45–3.71, respectively), but not among males. Female participants with both conditions had a significantly increased risk of falls after adjusting for potential confounders (OR: 3.50, 95% CI: 1.65–7.13) compared with those with neither condition; the association was not significant among males.

Conclusions: Depressive symptoms and visual impairment at age 64 were significantly associated with an increased risk of falls at age 70 in Japanese females but not in males. The combination of the two symptoms had an even greater association with fall risk.

Key Words: age-specific cohort, depressive symptoms, falls, visual impairment, young-old.

Introduction

Falls are a major public health issue especially among older people.[1] Approximately 30% of community-dwelling older people fall at least once annually and 5% of them consequently suffer fractures, potentially leading to disability and loss of independence.[2, 3] Even falls without injuries may cause fear of falling. This could decrease mobility and quality of life,[4] and could result in recurrent falls because a history of falls is one of the predictive factors of falling.[1, 2, 5]

Japan is the most highly aged society in the world and healthy aging, defined as "living without disability or loss of independence" is considered important.[6] Data from the Japanese Cabinet Office show that recently the average age of older people without disability or loss of independence is approximately 70 years of age.[7] In Japan, falls are the most frequent cause of requiring care for older adults, excluding cerebrovascular events and arthritic disorder even in the young-old age group (65–70 years);[8] therefore, prevention of falls in the young-old age group is crucial for healthy aging.

Ample research has explored risk factors associated with falls in older people, including muscle weakness, gait and balance impairment, cognitive impairment, previous history of falls, arthritis, depression and visual impairment.[1, 2, 5] However, some major risk factors associated with falls, including physical fragility and cognitive issues, are not common in the young-old age group. On the other hand, depressive symptoms and visual impairment are prevalent in older people even in the young-old.[9, 10] Some of these cases could be preventable or remediable through early detection, but are often underdiagnosed in communities.[11, 12] Lifestyles in the young-old age group, between the ages of 60 and 70, tend to change dramatically because of life events such as retirement, bereavement or disease.[6] Such life changes may account for a high prevalence of depressive symptoms. The average prevalence of depressive symptoms among older adults in communities has been reported as 13.5%,[13] Furthermore, data from the Health, Labour and Welfare Ministry showed depressive symptoms or bipolar disorder as occurring most frequently in females in their 60s or 70s.[14] The prevalence of visual impairment (best-corrected visual acuity <6/12) among older adults aged 65 is 3.65% and increases with aging; the major causes of visual impairment are age-associated eye diseases such as glaucoma and diabetic retinopathy in Japan.[15] Therefore, depression and visual impairment could be targets for fall prevention strategies in the young-old age group. However, the subjects of most previous studies investigating associations between depressive symptoms or visual impairment and falls have been in a broad older age group, with a mean age of 75 years or over.[10, 12] Indeed, few studies have investigated risk factors for falling among the young-old age group.

Evaluating the interactions among multiple falls risk factors is also relevant because some falls seem to result from several factors.[2] An increased number of risk factors increases the risk of falling.[3] Depressive symptoms and visual impairment are common in older people even in the young-old, and the odds ratio (OR) of depression is significantly higher among those with visual impairment (OR: 1.9, 95% CI: 1.6–2.3)[16] However, no studies address the combined effect of depressive symptoms and visual impairment on falls.

This study aimed to clarify the association between falls and depressive symptoms or visual impairment among the young-old age group using an age-specific cohort in Japan.

Material and Methods

Study population

The New Integrated Suburban Seniority Investigation (NISSIN) Project, an age-specific prospective cohort study, has been described in detail elsewhere.[6] Briefly, all residents living in Nisshin city, Japan, aged 64 at the first day of each year, were invited for a comprehensive health check-up and recruited for a cohort study every year from 1996 through 2005. The participants received follow-up health check-ups at the age of 70. In total, 3,073 participants (1,548 males and 1,525 females), or 43.9% of eligible residents, were enrolled. Of the 3,073 cohort members, we excluded 22 participants with missing baseline data for depressive symptoms or visual impairment. A further 818 participants were excluded based on a history of cancer, heart disease, cerebrovascular disease, back pain, or arthritis at baseline, which would affect the incidence of falls.[5] Of the remaining 2,233 participants (1182 males and 1051 females) at baseline, 90 participants died and 104 left the city during the 6 year follow-up period. If participants still lived in the city but did not attend the secondary health check-up, public health nurses performed at-home interviews; this included 617 (32.4%) at-home interviews. We lost contact with 135 participants at 70 years old. Data for 1,904 participants (986 males and 918 females, 83.4% and 87.3% of the eligible participants, respectively) were analyzed.

Baseline assessment

Baseline data were obtained at the participant's health check-up using a self-administered questionnaire. We used the shortened Geriatric Depression Scale to assess depressive symptoms;[17] the possible total score ranged from 0 to 15, with a higher score indicating more depressive symptoms. We defined depressive symptoms as a score of six or more; this cutoff point has a sensitivity of 81.5% and a specificity of 75.4%.[18] Visual impairment was assessed by asking "Have you been deprived of your sight in the previous month?" in the self-administered questionnaire. We defined visual impairment as the responder answering "yes."

Demographic information (marital status and education), lifestyle factors (smoking, drinking, exercise habit and walking speed), and history of comorbidity including hypertension, diabetes mellitus, and hypnotic use were obtained from the self-administered questionnaire. Body mass index (BMI) was calculated as measured weight in kilograms divided by measured height in meters squared, which was categorized into three categories (<18.5, 18.5-24.9, or ≥25.0 kg/m^2). Functional status was evaluated using the Tokyo Metropolitan Institute of Gerontology (TMIG) index of competence, which has been validated in the Japanese population;[19] the possible total score ranged from 0 to 13; a higher score indicating a greater competence level. We defined limitation of functional status as a score of 11 or less.

Ethical issues

For informed consent to participate in the study, oral consent was obtained using an opt-out approach from 1996 through 2001, and written consent using an opt-in approach from 2002 through 2005.[6] The study protocol was approved by the ethics committees of Nagoya University Graduate School of Medicine, the National Center for Geriatrics and Gerontology of Japan, the Aichi Medical University, and Hokkaido University Graduate School of Medicine.

Outcome variable

The outcome variable of our study was self-reported falls at the age of 70. Falls were ascertained by asking "Have you had injurious falls within the preceding year?" in the self-administered questionnaire. We defined "injurious falls" as falls which lead to bruising and/or other serious injuries such as fractures.

Statistical analysis

Chi-square or Fisher's tests statistically tested the difference between two groups (those with and without depressive symptoms or visual impairment). Multivariate odds ratios and 95% confidence intervals (CIs) of depressive symptoms and visual impairment for the incidence of falls were calculated using logistic regression models and adjusted for possible confounding factors, which included enrollment year, BMI, self-reported medical history of hypertension (yes or no), diabetes mellitus (yes or no), hypnotic use (yes or no), exercise habit (yes, no, or unknown), gait speed (slow, normal, fast, or unknown), and the TMIG index of competence (≤11, >11, or unknown).[19] We considered these variables as confounders based on previous reports.[20]

A supra-additive association between depressive symptoms and impaired vision was also assessed by calculating the relative excess risk due to interaction (RERI).[21] RERI was calculated as the OR (depressive symptoms + impaired vision + depressive symptoms × impaired vision) − OR (depressive symptoms) − OR (impaired vision) + 1. A *P*-value of <0.05 indicated statistical significance. All statistical analyses were performed using JMP Pro 10.0.0 for Windows (SAS Institute Inc., Cary, NC, USA).

Results

Overall, 77 (7.8%) male and 126 (13.7%) female participants reported falls within the previous year at age 70. Table 1 shows the baseline characteristics of the participants according to depressive symptoms and visual impairment. The prevalence of depressive symptoms was 16.3% (167/986) in males and 22.7% (208/918) in females, and that of visual impairment was 12.5% (123/986) and 15.7% (144/918) in males and females, respectively. Among both males and females, participants with depressive symptoms were less likely to be married or exercisers, and more likely to be slower walkers or to have lower functional status, compared with participants without depressive symptoms. Male participants with depressive symptoms were more likely to use hypnotics, and female participants with depressive symptoms were less likely to be well-educated. Participants with visual impairment had comparable characteristics to those without visual impairment in males, except hypnotic use was more prevalent in those with visual impairment. This was also true in females, except slower walkers were prevalent in females with visual impairment.

Table 2 shows the associations between falling and depressive symptoms or visual impairment. Among females, depressive symptoms were significantly associated with falls after adjusting for potential confounders (OR: 1.70, 95% CI: 1.09–2.62); this association was not found among males. Visual impairment was significantly associated with falls among females, but not males, after adjusting for potential confounders (OR: 2.34, 95% CI: 1.45–3.71).

Table 3 shows associations between falls and the combination of depressive symptoms and visual impairment. Compared with participants with neither depressive symptoms nor visual impairment, female participants with both depressive symptoms and visual impairment (OR: 3.50, 95% CI: 1.65–7.13), and those with only visual impairment (OR: 2.29, 95% CI: 1.26–4.03) had a significantly increased risk of falling after adjusting for potential confounders; these associations were not significant among males. RERI on the basis of the multivariable adjusted model for females was 0.060 (-0.12 - 0.24), indicating no significantly positive interaction on an additive scale.

Discussion

This age-specific community-based cohort study showed that self-reported depressive symptoms and visual impairment at age 64 significantly increased the risk of falls at age 70 in females after adjustment for potential confounding factors; the association was weaker and not significant in males. The combination of self-reported depressive symptoms and visual impairment significantly increased the association with falls among females; this was not a significant additive association. This result concurs with another study[3] demonstrating increased falls risk with multiple risk factors among older adults aged 75 or over. Our results suggest that the combination of the two symptoms majorly impacted on falls.

Finding depressive symptoms as a risk factor for falls derived in our young-old age group is similar to that from general older aged populations with an average age of 75 years.[12, 22-25] Our prospective study supports the finding that depressive symptoms may precede a fall, although the underlying mechanisms are still undetermined. Depressive symptoms might lead older people to fall via physiological and cognitive impairments;[12] physiological and cognitive factors mediate the impact of depression on falling.[26] Furthermore, symptoms of major depression include physiological and cognitive decline,[27] which were also reported to be risk factors for falls.[28] However, the associations between depressive symptoms and physiological or cognitive decline are complex, and may often develop concurrently.

Our finding that impaired vision is an independent risk for falls concurs with previous studies.[3, 29-32] Visual impairment is associated with falling because vision is a key sensory system for positional balance and gait.[11] People have visual impairment have a reduced capacity for detecting environmental hazards conducive to falling.[10] In most previous studies, visual functions including visual acuity, contrast sensitivity, and depth perception were measured optometrically.[3, 29-31] Here, we adopted self-reported impaired vision without clinical diagnosis or objective measurements. Yip et al. (2014)

showed a significant association between self-reported vision and falls after adjusting for visual acuity.[32] They also found positive associations between self-reported vision and objective visual acuity and suggested that self-reported vision could be a simple proxy measure of visual acuity.[32] Therefore, self-reported impaired vision would be appropriate for fall risk screening in community settings, where the prevalence of visual impairment may be underestimated.[10]

The incidence of falls during the year prior to age 70 years was 7.8% in males and 13.7% in females. These frequencies appear lower than findings in previous studies among older people in communities, especially in males.[1, 3] This difference might depend on our younger study population and our falls definition. A previous study reported that the incidence of falls within the previous year among those aged 70 to 74 years in a Japanese community was 15% in males and 26% in females.[33] They defined falls as any falling, but we defined falls as falls with injury. Approximately 50% of falls include injury.[5, 20] Therefore, the annual falling rate of our study participants would be reasonable in the Japanese population.

We found similar, although statistically insignificant, associations between depressive symptoms and/or visual impairment and falls in males. This sex difference may be partly explained by the relatively small number of fallers in males; possibly due to muscle mass decreasing faster in females than in males, most notably after menopause.[34] Another reason could be sex differences in the outcome variable at 70 years of those with depressive symptoms. The number of participants with depressive symptoms at the age of 65 years at baseline who died, left the city, and were lost to follow-up during the follow-up period were 219, 20(9.1%), 14(6.4%) and 18(8.2%) among males, respectively, and 237, 3(1.3%), 12(5.1%) and 14(5.9%) among females, respectively. More males with depressive symptoms tended to die during follow-up, possibly explaining fewer fallers among males than females.

The strength of our study is that we focused on the young-old population, ages 65–70 years, in an investigation based on an age-specific older population cohort study with a large cohort.[6] Most cohort studies that include people with a wide range of ages adjust for age using multivariable regression. However, there could remain an unadjustable age contribution, because age effects are not always log-linear.[6] Our age-specific cohort allowed us to show the associations between subjective depression and visual impairment at age 65 years and falls at age 70 years without age-derived biases. Our results are also important for fall prevention strategies in the early stages of the young-old age group, because depression and visual impairment are common even in this age group, and both situations are often underdiagnosed in communities.[9, 10] Moreover, some of these cases could be preventable or remediable through early detection.[11, 12]

Our study has several potential limitations. First, we did not specifically ask about the use of anti-depressants, which are reported to be an independent risk factor for falling.[35] If some participants with depressive symptoms were under anti-depressant treatment, the contribution of depressive symptoms might be overestimated by an added positive effect of anti-depressants on falls. Conversely, participants whose depressive symptoms had been alleviated by an anti-depressant could be categorized as "participants without depressive symptoms." These participants could have increased risks of falling through anti-depressant use. In this case, the associations might be underestimated. Second, our study relied on a self-reported measure of falls. This method is widely used in epidemiological studies; a systematic review showed that prospective data collection methods such as a fall calendar were used in only 41% randomized controlled studies.[36] However, as Mackenzie et al reported, retrospective self-reported falls data are less accurate than prospective calendar-reported methods (percentage agreement 84%) and tend to be under-reported.[37] Therefore, it is possible that our results underestimated the incidence of fall events. Third, we assessed depressive symptoms or impaired vision only at baseline, and that information was not updated; therefore, symptoms could have changed during the follow-up period. Lastly, our participants were a relatively healthier group than the general Japanese population regarding factors such as frequency of smoking, obesity or hypertension.[6] Therefore, selection bias should be considered when generalizing our study data; however our results from this relatively healthier population could be valuable for population-based prevention strategies.

In conclusion, self-reported depressive symptoms and visual impairment at age 65 years significantly increased the risk of falls at age 70 years in a Japanese female population, and the combination of the two symptoms had an even greater association with falls. Self-reported screening for depressive symptoms and visual impairment may aid population-based prevention strategies for falls even among young-older people, because some depressive symptoms and visual impairment could be reversible.

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Disclosure statement

No potential conflicts of interest were disclosed.

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Table 1 Baseline characteristics of the study participants

		Male (n=986)						Female (n=918)					
		Without depressive symptoms (n=819)	With depressive symptoms (n=167)	*P value	Without impaired vision (n=863)	With impaired vision (n=123)	*P value	Without depressive symptoms (n=710)	With depressive symptoms (n=208)	*P value	Without impaired vision (n=774)	With impaired vision (n=144)	*P value
Marital status	Married	784 (95.7)	153 (91.6)		817 (94.7)	120 (97.6)		601 (84.9)	160 (77.3)		638 (82.8)	123 (85.4)	
	Divorced/Widowed/Single	35 (4.3)	14 (8.4)	0.0259	46 (5.3)	3 (2.4)	0.1675	107 (15.1)	47 (22.7)	0.0102	133 (17.2)	21 (14.6)	0.4323
Education	Elementary/ Junior	222 (27.2)	55 (32.9)		244 (28.4)	33 (26.8)		221 (31.2)	101 (48.5)		279 (36.1)	43 (29.9)	
	High school	323 (39.6)	69 (41.3)		344 (40.0)	48 (39.0)		370 (52.2)	80 (38.5)		372 (48.1)	78 (54.2)	
	College/University above	271 (33.2)	43 (25.8)	0.1265	272 (31.6)	42 (34.2)	0.8478	118 (16.6)	27 (13.0)	<0.0001	122 (15.8)	23 (16.0)	0.3249
Smoking	Never	166 (20.3)	30 (18.0)		180 (20.9)	16 (13.0)		660 (93.0)	188 (90.4)		722 (93.3)	126 (87.5)	
	Past	403 (49.2)	73 (43.7)		412 (47.7)	64 (52.0)		30 (4.2)	11 (5.3)		31 (4.0)	10 (6.9)	
	Current	250 (30.5)	64 (38.3)	0.1432	271 (31.4)	43 (35.0)	0.124	20 (2.8)	9 (4.3)	0.4309	21 (2.7)	8 (5.6)	0.0525
Drinking	Non	236 (28.8)	56 (33.7)		257 (29.8)	35 (28.5)		562 (79.1)	176 (84.6)		627 (81.0)	111 (77.1)	
	Current	583 (71.2)	110 (66.3)	0.2057	605 (70.2)	88 (71.5)	0.7575	148 (20.9)	32 (15.4)	0.0811	147 (19.0)	33 (22.9)	0.2761
BMI	<18.5kg/m2	34 (4.2)	11 (6.6)		38 (4.4)	7 (5.7)		37 (5.2)	11 (5.3)		39 (5.0)	9 (6.2)	
	18.5-24.9	585 (71.4)	117 (70.1)		610 (70.7)	92 (74.8)		533 (75.1)	152 (73.1)		575 (74.3)	110 (76.4)	
	25≤	200 (24.4)	39 (23.3)	0.3859	215 (24.9)	24 (19.5)	0.3786	140 (19.7)	45 (21.6)	0.8267	160 (20.7)	25 (17.4)	0.5849
Medical history	Hypertension	207 (25.1)	42 (25.2)	0.973	217 (25.1)	32 (26.0)	0.8351	163 (23.0)	45 (21.6)	0.6885	184 (23.8)	24 (16.7)	0.0614
	Diabetes Mellitus	76 (9.3)	17 (10.2)	0.7168	80 (9.3)	13 (10.6)	0.6447	33 (4.7)	4 (1.9)	0.0789	33 (4.3)	4 (2.8)	0.4052
	Hypnotic use	4 (0.49)	4 (2.4)	0.0046	5 (0.58)	3 (2.4)	0.0125	15 (2.1)	4 (1.9)	0.2719	17 (2.2)	2 (1.4)	0.2603
Exercise habit	Yes	439 (53.7)	73 (44.0)		450 (52.3)	62 (50.4)		380 (53.6)	75 (36.1)		389 (50.3)	66 (45.8)	
	No	379 (46.3)	93 (56.0)	0.0227	411 (47.7)	61 (49.6)	0.6996	329 (46.4)	133 (63.9)	<0.0001	384 (49.7)	78 (54.2)	0.3225
Walking speed	slow	60 (7.3)	26 (16.2)		74 (8.6)	13 (10.7)		68 (9.6)	45 (21.7)		87 (9.5)	26 (18.1)	
	normal	629 (76.9)	131 (78.4)		667 (77.3)	93 (76.2)		538 (75.8)	148 (71.5)		590 (76.3)	96 (66.7)	
	fast	129 (15.8)	9 (5.4)	<0.0001	122 (14.1)	16 (13.1)	0.7337	104 (14.6)	14 (6.8)	<0.0001	96 (12.4)	22 (15.3)	0.0327
TMIG	≤11	195 (23.8)	72 (43.1)		231 (26.8)	36 (29.3)		99 (13.9)	60 (28.9)		128 (16.5)	31 (21.5)	
	11<	624 (76.2)	95 (59.9)	<0.0001	632 (73.2)	87 (70.7)	0.5592	611 (86.1)	148 (71.1)	<0.0001	646 (83.5)	113 (78.5)	0.1462

BMI = body mass index; TMIG = Tokyo Metropolitan Institute of Gerontology index of competence
Values are expressed as numbers (percent)
*P value from chi-square test or Fisher's test

Table 2 Associations between falls and depressive symptoms or impaired vision

		Male				Female			
		n	Number of fallers (%)	Enrollment year adjusted OR (95% CI)	aOR (95% CI) †	n	Number of fallers (%)	Enrollment year adjusted OR (95% CI)	aOR (95% CI) †
Depressive symptoms	Yes	167	16 (9.6)	1.38（0.74-2.44）	1.22 (0.63-2.25)	208	41 (19.7)	1.75(1.15-2.64）*	1.70 (1.09-2.62)*
	No	819	61(7.5)	ref	ref	710	85 (12.0)	ref	ref
Impaired vision	Yes	123	10 (8.1)	1.12（0.52-2.16）	1.05 (0.48-2.07)	144	32 (22.2)	2.23(1.40-3.49）*	2.34(1.45-3.71)*
	No	863	67 (7.8)	ref	ref	774	94 (12.1)	ref	ref

OR = odds ratio; aOR = adjusted odds ratio

* *P* value <0.05

† Adjusted for enrollment year, hypertension, diabetes mellitus, body mass index, exercise habit, hypnotic use, walking speed and Tokyo Metropolitan Institute of Gerontology index of competence

Table 3 Associations between falls and the combination of depressive symptoms and impaired vision

	Without depressive symptoms, without impaired vision	With depressive symptoms, without impaired vision	Without depressive symptoms, with impaired vision	With depressive symptoms, with impaired vision	RERI (95%CI)
Male (n=986)	731	132	88	35	
No of fallers (%)	54 (7.4)	13 (9.6)	7 (8.0)	3 (8.6)	
Enrollment year adjusted OR (95%CI)	ref	1.41 (0.71-2.63)	1.13 (0.45-2.44)	1.33 (0.31-4.00)	-0.036 (-0.41 - 0.33)
Multivariate OR (95%CI) †	ref	1.25 (0.60-2.42)	1.06 (0.42-2.37)	1.16 (0.26-3.65)	-0.025 (-0.41 - 0.36)
Female (n=918)	612	162	98	46	
No of fallers (%)	66 (10.8)	28 (17.3)	19 (19.4)	13 (28.3)	
Enrollment year adjusted OR (95%CI)	ref	1.67 (1.01-2.69)*	2.17 (1.20-3.78)*	3.33 (1.60-6.58)*	0.053 (-0.13 - 0.23)
Multivariate OR (95%CI) †	ref	1.62 (0.96-2.68)	2.29 (1.26-4.03)*	3.50 (1.65-7.13)*	0.060 (-0.12 - 0.24)

OR = odds ratio; RERI = relative excess risk due to interaction

* *P* value <0.05

† Adjusted for enrollment year, hypertension, diabetes mellitus, body mass index, exercise habit, hypnotic use, walking speed and Tokyo Metropolitan Institute of Gerontology index of competence