

Utility of an ADL Index for Institutionalized Elderly People: Examining Possible Applications for Independent Elderly People

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Abstract

The purpose of this study was to clarify the application range and utility of an ADL index for disabled elderly people (Demura et al., 2000), by examining the ADL characteristics of an elderly population when this index was applied to disabled and independent elderly people. Subjects of this study were 697 Japanese institutionalized disabled elderly people and 482 independent elderly people (ID) living at home. Disabled elderly people were classified into four groups based on conditions of use of assisting devices for movement; D1 did not use assisting devices; D2 used a stick or a walker; D3 used a wheelchair; D4 was immobile. From the findings of comparing achievement proportions, ADL score and the distribution of total score among elderly groups, it was suggested that this ADL index can assess gradually from disabled elderly people who cannot move to independent elderly people. Since this index classifies independent elderly people and disabled elderly people with high probability, it can evaluate if elderly people can maintain a functional level needed for independent living, and can recognize the symptoms of disability. Furthermore, this study proposed useful activities to discriminate the functional level for each elderly group. Although it is important to comprehensively assess ADL ability, further use of this ADL index to discriminate the functional level of an elderly population, by making use of these useful activities, is expected.

Key words: ADL, disabled elderly people, independent elderly people, discriminant analysis, Japanese

Introduction

It is important to determine if elderly people are living independently, since the problem influences not only the elderly but also their families or communities¹. Methods to assess functional ability of elderly people using activities of daily living (ADL) have been developed^{1–13}. The elderly population includes bedridden elderly people who can achieve only a few low-difficulty activities and independent elderly people who can achieve high-difficulty activities¹⁴. Therefore, an ADL index that can assess a wide range of functional ability would be very useful¹⁴.

We developed an ADL index for institutionalized disabled elderly people¹. This index guaranteed unidimensionality of the scale and assumed continuity of ADL ability. Furthermore, this index can apply to a range of disabled elderly people who can move without assistance devices to elderly people who are immobile, and proposed some useful items corresponding to functional

levels of disabled elderly people¹. This ADL index consists of ADL items with various levels of difficulty. If ADL items that are useful in discriminating dependent and independent elderly people or items that can commonly assess ADL ability of independent elderly people can be determined, the applicable range and the evaluation of this ADL index would be more enhanced. In addition, extending the utility of this ADL index in the sense that it can continually assess the ADL ability of elderly people with various functional levels and recognize the symptoms of disability of independent elderly people is expected.

The purpose of present study was to clarify the application range and utility of the ADL index for disabled elderly people¹, by examining the ADL characteristics of an elderly population when this index is applied to disabled and independent elderly people.

Materials and Methods

1. Subjects

The subjects of present study were 697 Japanese dependent and disabled elderly people living at welfare institutions for the aged, such as special homes for the aged and health facilities (173 males, mean age: 80.0±7.4 years; 524 females, mean age: 81.9±7.5) and 482 independent elderly people (ID) living at home

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Table 1 Sample size and mean ages of each elderly group

		60s group			70s group			80s group					
		n	mean	SD	n	mean	SD	n	mean	SD			
Independent elderly people	Male	76	65.5	2.5	74	74.6	2.8	30	83.4	3.4			
	Female	100	65.9	2.6	84	74.3	3.1	45	84.9	3.9			
Disabled elderly people	Male	18	65.7	2.1	60	75.9	2.7	95	85.3	4.1			
	Female	34	66.0	2.6	146	75.6	2.9	344	86.1	4.6			
		Without assistance			Stick or Walker			Wheelchair			Immobile		
	Male	62	80.1	6.0	18	82.7	6.5	49	79.9	8.9	41	78.0	6.7
	Female	134	81.4	5.9	138	82.8	7.3	143	82.4	8.3	99	80.5	7.9

N.B. Significant age differences were found in both groups of independent and disabled elderly groups.

A significant difference was found among mean ages of four disabled elderly groups with different ambulatory activity levels.

(213 males, mean age: 72.5±6.8 years; 269 females, mean age: 73.2±7.6 years). There were no significant gender difference but there were significant group differences within the mean ages of the three age groups of the 60s, 70s and 80s in both elderly groups (Table 1).

Disabled elderly people ranged from rank A (house-bound) to rank C (bed-bound) of the standard for the degree of independence for disabled elderly people, approved by the Japan Ministry of Health and Welfare in 1991. Disabled elderly people were selected at random by the staff working at the subjects' institutions, such as OTs, PTs and nurses. As a result of investigating assistance devices for movement, 194 elderly people did not use assistance devices (62 males and 134 females; D1), 156 used a stick or a walker (18 males and 138 females; D2), 192 used a wheelchair (49 males and 142 females; D3), and 140 were immobile (41 males and 99 females; D4). There was no significant gender difference

but there were significant group differences within the mean ages of these four disabled groups. However, since there was a significant difference in mean age among the four disabled groups and the independent elderly group, the effect of age was controlled when ADL scores were compared among elderly groups.

2. ADL index

This study used an ADL index for institutionalized disabled elderly people developed in our previous studies^{1,15}. This index was constructed with 27 items and used a dichotomous rating scale of "possible" or "impossible" (Table 2). Considering previous studies^{1,2,4-12,15}, these 27 items were selected from the following nine ADL domains; 1) movement, 2) going up and down stairs, 3) changing and holding the posture, 4) bathing, 5) using the toilet, 6) dressing, 7) grooming, 8) eating, and 9) manual activities. The reliability (alpha coefficient was 0.986; agreement rates

Table 2 ADL items

	ADL domains	Item No.	Contents
I	Movement	1	Walking to an adjoining room
		2	Crossing the doorstill
II	Going up and down stairs	3	Going up stairs
III	Changing and holding posture	4	Sitting up from a lying posture
		5	Sitting on a chair from a standing posture
		6	Squatting down from a standing posture
		7	Tossing about in bed
		8	Maintaining a sitting posture
		9	Keeping a standing posture
		10	Entering the bathtub
IV	Bathing	11	Washing the hair in the bath
		12	Drying the body with a towel after bathing
		13	Squeezing a wet towel
V	Using the Toilet	14	Using a Western-style lavatory
		15	Pulling up and down underwear when excreting
		16	Controlling urination
VI	Dressing	17	Putting on pants and a skirt from a standing posture
		18	Putting on shoes without laces
		19	Putting on a long-sleeved shirt with buttons
VII	Grooming	20	Clasping buttons
		21	Washing the face
		22	Wiping the body with a towel
VIII	Eating	23	Washing hands
		24	Eating with chopsticks
		25	Eating while holding tableware at the table
IX	Manual activity	26	Tying a string
		27	Opening and closing a drawer

for items were 0.85 to 1.00) and unidimensionality (coefficient of reproducibility was 0.921) of the scale were previously confirmed¹⁾. Furthermore, more useful items to assess ADL ability were proposed, corresponding to each disabled elderly group based on assistance devices for movement.

3. Data collection

The survey for the disabled elderly people was conducted in each subjects' institution. The survey duration at each institution ranged between four and six weeks. The staff working at the subjects' institutions, such as OTs, PTs and nurses, responded to the ADL index survey. For the independent elderly people living at home, the subjects provided their own information.

4. Statistic analyses

The achievement proportions and score for each item, and the distribution of total score were compared among five elderly D1, D2, D3, D4 and ID groups, in order to examine ADL ability characteristics for each elderly group. Item scores, "possible to achieve" = 1 and "impossible to achieve" = 0, and total score were calculated on a 27 point scale. For these ADL scores, gender and elderly group differences were examined using two-way ANOVA, considering the effect of age. If the main effects were significant, multiple comparisons using Tukey's HSD test were conducted. The cumulative relative frequency distribution of total score was calculated for the four disabled elderly groups and three independent elderly groups, the 60s, 70s and 80s age groups. In addition, to examine the possibility of discriminating functional level of elderly people, discriminant analysis was applied to five elderly groups (D1, D2, D3, D4 and ID) and the four disabled elderly groups. Discriminant analysis used the elderly group as the dependent variable, and 27 item scores and age as independent variables.

Results

1. Comparison of ADL score among elderly groups

Table 3 shows the results of two-way (gender x five elderly groups) ANOVA for each item score and total score. In the total score, only a significant group difference was found. Total scores were significantly higher in the following order; ID, D1 (without assisting devices), D2 (using a stick or a walker), D3 (using a

wheelchair) and D4 (independently immobile). Significant group differences were found in all ADL items except six items showing a significant interaction effect. Scores of these items were also significantly higher in the same order as the total score. Gender differences were found in only three items, "washing the face", "washing hands," "tying a string," and females were superior to males in all three item scores.

Table 4 shows achievement proportions for each elderly group. For the independent elderly groups, item proportions were more than 90% in the 60s group. However, item proportions decreased with aging, only four items showed more than 90% in the 80s group. However, for disabled elderly groups, item proportions decreased as ambulatory activity level declined, and all item proportions excepting three items were less than 10% in D4.

2. Distribution of total score

Figure 1 shows the cumulative relative frequency distribution curves of each of the elderly groups. The steeper slope of the curve means that the frequency at a score is higher. The appearance of the curve on the right or left side indicates that the frequency distributions incline towards a higher or lower score range, respectively. The distribution of independent elderly people inclined towards the higher score range, and more than 80% of the independent elderly people showed a perfect score. In a comparison of age-groups of independent elderly people, the curves shifted to a lower score range with age in the order of the 60s, 70s and 80s age groups. In the case of disabled elderly people, the frequencies were distributed equally at each score, and the curves linearly compared with independent elderly groups. The curves of the disable groups shifted to a higher score range in the order of D4, D3, D2 and D1. The total scores for D4 were under eight, and the distribution of D4 inclined to a lower score range compared with other disabled elderly groups.

3. Discriminant analysis

Table 5 shows the result of discriminant analysis for five elderly groups (four disabled groups and one independent group). The following four discriminant functions were obtained; the first discriminant function (F1) classified ID and four disabled groups; the second function (F2) classified D1 and three other disabled groups; the third function (F3) classified D2 and the two groups D3 and D4; and the fourth function (F4) classified D3 and D4.

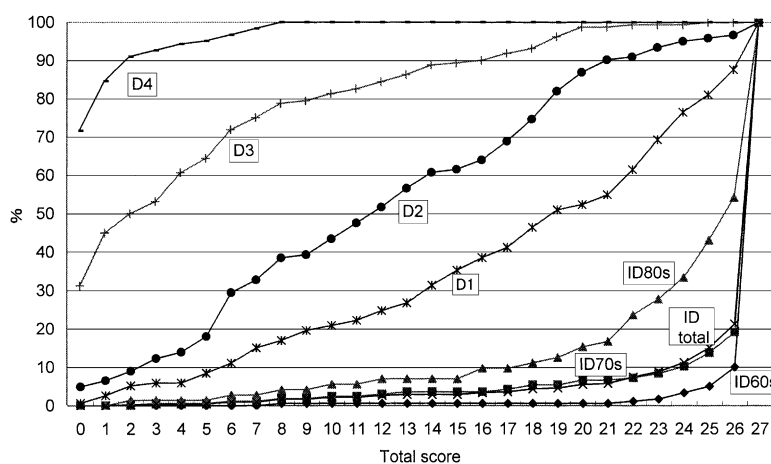


Fig. 1 Cumulative relative frequency distribution curves for each elderly group.

N.B. D1, D2, D3, D4 correspond to Table 2. ID60s, ID70s, ID80s are 60s, 70s, 80s groups of independent elderly people, respectively.

Table 3 Gender and elderly group differences of ADL scores

ADL domains	Item No.		ID			D1			D2			D3			D4			Two-way ANOVA (covariable: age)			
			n	mean	SD	n	mean	SD	n	mean	SD	n	mean	SD	n	mean	SD	A	B	C	multiple comparisons
I Movement	1	M	208	0.96	0.19	62	0.73	0.45	18	0.17	0.37	48	0.04	0.20	38	0.03	0.16	**		ID>D1>D2>D3,D4	
		F	264	0.96	0.20	133	0.71	0.45	138	0.24	0.43	143	0.03	0.16	99	0.00	0.00				
	2	M	207	0.95	0.21	62	0.65	0.48	18	0.06	0.23	49	0.04	0.20	37	0.03	0.16	**		ID>D1>D2,D3,D4	
		F	266	0.94	0.23	131	0.59	0.49	137	0.15	0.35	142	0.02	0.14	99	0.00	0.00				
II Going up and down stairs	3	M	208	0.91	0.28	60	0.35	0.48	17	0.06	0.24	47	0.00	0.00	38	0.03	0.16	**		ID>D1>D2,D3,D4	
		F	264	0.86	0.35	130	0.36	0.48	136	0.10	0.30	140	0.01	0.08	99	0.00	0.00				
III Changing and holding posture	4	M	210	0.96	0.19	62	0.69	0.46	18	0.28	0.45	49	0.39	0.49	38	0.05	0.22	**		ID>D1>D2,D3>D4	
		F	264	0.92	0.27	133	0.71	0.45	138	0.47	0.50	141	0.28	0.45	99	0.03	0.17				
	5	M	210	0.95	0.22	62	0.69	0.46	18	0.28	0.45	48	0.21	0.41	38	0.03	0.16	**		ID>D1>D2>D3>D4	
		F	266	0.95	0.22	131	0.70	0.46	138	0.43	0.49	140	0.17	0.38	99	0.00	0.00				
	6	M	208	0.91	0.28	62	0.34	0.47	17	0.06	0.24	47	0.02	0.14	38	0.03	0.16	**		ID>D1>D2,D3,D4	
		F	264	0.85	0.35	128	0.41	0.49	133	0.08	0.26	143	0.03	0.18	99	0.00	0.00				
	7	M	209	0.97	0.17	60	0.82	0.39	18	0.78	0.42	46	0.46	0.50	39	0.15	0.36	**	**	M:ID>D1,D3,D4 F:ID>D1,D2>D3,D4	
		F	261	0.98	0.12	133	0.89	0.32	138	0.82	0.39	141	0.30	0.46	99	0.14	0.35				
	8	M	206	0.94	0.24	61	0.70	0.46	18	0.50	0.50	47	0.36	0.48	39	0.05	0.22	**		ID>D1,D2>D3,D4	
		F	258	0.89	0.31	134	0.62	0.49	137	0.58	0.49	141	0.19	0.39	99	0.08	0.27				
	9	M	207	0.92	0.27	62	0.47	0.50	18	0.06	0.23	48	0.04	0.20	39	0.03	0.16	**		ID>D1>D2,D3,D4	
		F	257	0.89	0.31	133	0.47	0.50	138	0.17	0.37	143	0.03	0.16	99	0.00	0.00				
IV Bathing	10	M	211	0.92	0.27	62	0.42	0.49	18	0.06	0.23	48	0.06	0.24	38	0.03	0.16	**		ID>D1>D2,D3,D4	
		F	263	0.92	0.28	132	0.52	0.50	137	0.13	0.34	139	0.03	0.17	99	0.00	0.00				
	11	M	210	0.93	0.26	61	0.43	0.49	18	0.22	0.42	46	0.11	0.31	38	0.00	0.00	**		ID>D1>D2,D3>D4	
		F	261	0.93	0.25	131	0.45	0.50	134	0.30	0.46	138	0.14	0.35	99	0.00	0.00				
	12	M	209	0.93	0.25	59	0.53	0.50	18	0.22	0.42	48	0.15	0.35	38	0.00	0.00	**		ID>D1>D2,D3>D4	
		F	266	0.94	0.23	131	0.63	0.48	136	0.40	0.49	139	0.16	0.36	99	0.01	0.10				
	13	M	207	0.94	0.23	61	0.44	0.50	18	0.28	0.45	49	0.18	0.39	38	0.03	0.16	**		ID>D1>D2,D3>D4	
		F	265	0.94	0.24	131	0.56	0.50	137	0.39	0.49	141	0.21	0.41	99	0.01	0.10				
V Using the toilet	14	M	208	0.95	0.21	59	0.68	0.47	17	0.29	0.46	48	0.21	0.41	38	0.03	0.16	**		ID>D1>D2,D3>D4	
		F	265	0.96	0.20	131	0.70	0.46	136	0.45	0.50	139	0.25	0.43	98	0.00	0.00				
	15	M	209	0.96	0.20	62	0.61	0.49	18	0.44	0.50	49	0.14	0.35	38	0.00	0.00	**		ID>D1>D2>D3>D4	
		F	265	0.95	0.21	133	0.76	0.43	137	0.51	0.50	142	0.13	0.33	99	0.01	0.10				
	16	M	207	0.96	0.20	60	0.68	0.47	18	0.72	0.45	49	0.43	0.49	38	0.08	0.27	*		M:ID>D1>D4/ID>D3 F:ID>D1,D2>D3>D4	
		F	262	0.95	0.21	133	0.74	0.44	137	0.78	0.41	141	0.30	0.46	99	0.02	0.14				
VI Dressing	17	M	208	0.87	0.34	59	0.27	0.44	18	0.00	0.00	49	0.06	0.24	38	0.00	0.00	**		ID>D1>D2,D3,D4	
		F	260	0.84	0.36	131	0.37	0.48	137	0.12	0.33	139	0.03	0.17	98	0.00	0.00				
	18	M	208	0.96	0.20	60	0.75	0.43	17	0.35	0.48	46	0.24	0.43	38	0.00	0.00	**		ID>D1>D2>D3>D4	
		F	261	0.94	0.24	132	0.67	0.47	136	0.48	0.50	138	0.14	0.34	99	0.00	0.00				
	19	M	208	0.95	0.22	62	0.56	0.50	18	0.28	0.45	49	0.18	0.39	38	0.00	0.00	*	D2:F>M	M:ID>D1>D2,D3,D4 F:ID>D1,D2>D3>D4	
		F	261	0.95	0.21	132	0.64	0.48	138	0.53	0.50	142	0.19	0.39	99	0.01	0.10				
	20	M	208	0.94	0.24	61	0.21	0.41	17	0.06	0.24	49	0.04	0.20	40	0.00	0.00	**	D3:F>M	M:ID>D1>D2,D3,D4 F:ID>D1,D3>D4/ID>D2	
		F	260	0.95	0.21	132	0.33	0.47	137	0.20	0.40	139	0.20	0.40	98	0.00	0.00				
VII Grooming	21	M	208	0.99	0.10	60	0.78	0.41	17	0.47	0.50	48	0.17	0.37	40	0.03	0.16	**	**	F>M ID>D1>D2>D3,D4	
		F	261	0.99	0.09	133	0.79	0.41	138	0.62	0.49	141	0.17	0.38	99	0.06	0.24				
	22	M	208	0.95	0.22	59	0.64	0.48	17	0.24	0.42	48	0.19	0.39	39	0.03	0.16	*	D2:F>M	M:ID>D1>D2,D3,D4 F:ID>D1>D2>D3,D4	
		F	261	0.95	0.21	133	0.70	0.46	138	0.51	0.50	140	0.18	0.38	97	0.05	0.22				
	23	M	209	0.97	0.18	61	0.84	0.37	18	0.78	0.42	47	0.38	0.49	38	0.03	0.16	**	**	F>M ID>D1,D2>D3>D4	
		F	261	0.98	0.12	134	0.87	0.34	137	0.89	0.31	140	0.41	0.49	95	0.11	0.31				
VIII Eating	24	M	209	0.97	0.17	60	0.68	0.47	18	0.78	0.42	48	0.23	0.42	39	0.00	0.00	**	D3:F>M	M:ID>D1>D3,D4/D2>D3,D4 F:ID>D1,D2>D3>D4	
		F	260	0.97	0.17	132	0.78	0.41	135	0.76	0.43	140	0.31	0.46	98	0.11	0.32				
	25	M	208	0.95	0.21	60	0.88	0.32	18	0.83	0.37	48	0.44	0.50	39	0.13	0.33	**		ID>D2>D3,D4/D1>D3,D4	
		F	260	0.97	0.17	132	0.91	0.29	135	0.90	0.30	142	0.38	0.49	97	0.18	0.38				
IX Manual activity	26	M	207	0.93	0.25	60	0.47	0.50	16	0.44	0.50	48	0.17	0.37	38	0.03	0.16	**	**	F>M M:ID>D1>D2,D3,D4 F:ID>D1,D2>D3>D4	
		F	262	0.97	0.18	129	0.60	0.49	129	0.53	0.50	139	0.25	0.43	99	0.04	0.20				
	27	M	209	0.97	0.17	61	0.87	0.34	18	0.67	0.47	44	0.45	0.50	38	0.11	0.31	**		ID>D1,D2>D3>D4	
		F	262	0.96	0.20	132	0.81	0.39	137	0.79	0.41	139	0.39	0.49	96	0.10	0.31				
Total score		M	206	26.1	3.4	59	17.4	8.1	17	9.2	6.8	44	6.9	5.9	37	3.3	4.4	**		ID>D1>D2>D3>D4	
		F	258	25.7	3.7	128	18.2	7.4	133	13.4	6.7	138	7.4	6.2	95	2.7	2.3				

N.B. ID: Independent elderly people. Disabled elderly people groups were as follows; D1 can move without assisting devices, D2 use a stick or a walker, D3 use a wheelchair, D4 is immobile.

“A”, “B” and “C” mean the main effects of gender and elderly group factors and interaction in two-way ANOVA. “M” and “F” mean Male and Female in multiple comparisons.

** : p<0.01, * : p<0.05.

Item No. corresponds to Table 2.

Table 4 Achievement proportions of ADL items for each elderly group

ADL domains	Item No.	Independent elderly people				Disabled elderly people				
		Total	60s	70s	80s	Total	D1	D2	D3	D4
II Going up and down stairs	3	88.1	96.9	89.5	66.3	12.7	35.7	9.7	0.0	0.7
VI Dressing	17	85.3	97.9	84.8	59.1	13.6	29.8	8.9	3.2	0.0
III Changing and holding posture	6	87.9	95.3	88.9	69.7	14.2	36.3	6.3	2.4	0.7
VI Dressing	20	94.7	98.9	95.8	83.1	18.0	26.4	15.9	5.6	0.0
IV Bathing	10	91.8	99.0	91.6	76.9	18.1	46.3	12.3	4.1	0.7
III Changing and holding posture	9	90.5	94.7	93.0	75.9	18.5	47.2	12.9	0.8	0.7
I Movement	2	94.7	99.5	96.3	81.1	21.1	59.8	13.0	1.6	0.7
IV Bathing	11	93.0	99.0	92.6	80.9	23.5	42.8	26.6	11.7	0.0
I Movement	1	96.0	99.5	96.8	86.5	27.4	69.9	20.4	2.4	0.7
IV Bathing	13	94.1	98.5	93.6	85.6	30.0	50.6	35.6	11.9	1.5
IV Bathing	12	93.9	99.0	93.7	83.5	30.3	57.9	36.6	11.4	0.7
VI Dressing	19	95.1	98.9	95.3	86.5	34.5	60.0	47.6	19.7	0.7
VI Dressing	18	94.7	99.5	95.3	83.1	34.8	68.8	46.5	18.3	0.0
IX Manual activity	26	95.1	98.4	95.3	87.6	34.9	55.3	50.0	25.8	3.6
III Changing and holding posture	5	95.0	99.0	94.8	86.8	35.2	67.8	38.8	16.8	0.7
V Using the Toilet	15	95.6	99.5	95.8	86.8	35.6	69.9	50.0	15.7	0.7
VII Grooming	22	95.1	99.5	95.3	85.4	36.7	66.7	46.6	18.5	4.4
V Using the Toilet	14	95.6	99.5	95.8	86.7	37.2	66.7	41.0	16.0	0.7
III Changing and holding posture	8	91.2	95.3	94.6	75.3	38.9	68.7	58.9	33.1	7.2
III Changing and holding posture	4	93.9	97.9	94.8	83.1	40.9	69.3	42.9	31.0	3.6
VII Grooming	21	99.1	100.0	100.0	95.5	41.0	80.5	61.6	25.6	5.0
V Using the Toilet	16	95.5	99.5	96.3	85.2	47.6	71.3	78.1	42.5	3.6
VIII Eating	24	97.0	98.4	98.4	90.9	48.2	75.7	76.6	34.9	8.0
III Changing and holding posture	7	97.9	99.0	99.5	92.1	55.0	89.7	83.0	45.5	14.5
IX Manual activity	27	96.4	100.0	97.9	85.4	55.5	82.2	76.0	37.5	10.4
VII Grooming	23	97.7	99.5	99.0	91.0	58.4	84.7	87.0	41.5	8.3
VIII Eating	25	96.2	97.9	97.9	88.6	59.7	90.8	88.9	49.6	16.2

N.B. Shadowed items indicate more than 90% or less than 10%. Items ordered based on achievement proportions of total disabled elderly people. Item No. corresponds to Table 2.

From the discriminant function coefficients and the structure matrix (correlation between the discriminant function and each variable), 19 items concerning movement, going up and down stairs, bathing, using the toilet, and dressing and grooming were more related to F1. Two items, “clasping buttons” and “eating while holding tableware on the table”, were more related to F2. Three items, “controlling urination” “washing hands” and “eating with chopsticks”, and two items, “sitting up from the lying posture” and “using a Western-style lavatory”, were more related to F3 and F4, respectively. Discriminant probabilities using these four functions were 76.2% in total, 94.5% in ID, 51.7% in D1, 64.3% in D2, 55.2% in D3, 65.7% in D4. As a result of the discriminant analysis of the four disabled groups, the following three discriminant functions were obtained; the first function classified D1 and three other groups; the second function classified D2 and the two groups D3 and D4; the third function classified D3 and D4. The discriminant probabilities using these functions were 71.2% in total, 79.5% in D1, 67.8% in D2, 66.7% in D3, 60.0% in D4. Furthermore, in both of the results of discriminant analyses, age was significantly related to discriminant functions.

Discussion

In general, it is considered that independent elderly people are superior to disabled elderly people in ADL ability, and that in disabled elderly people, the ADL ability level becomes gradually higher as the ambulatory activity level advances. In present study, as a result of comparing ADL scores among elderly groups, the

same trend was confirmed. In the achievement proportions of each elderly group, most of the 60s group of ID could achieve all ADL items. ADL ability of ID decreased with age, however, there were individual differences in the achievement level for many items in the 80s group. Concerning the distribution of total score, since many independent elderly people indicated a perfect score, it is suggested that ADL items using this index are too easy for ID. However, the score distribution curve for ID shifted gradually towards a low-score range with advancing age. These findings suggest that a perfect score with this index means an independent living level, and that this index can recognize the symptoms of disability with aging in ID. In contrast, achievement proportions for disabled elderly people decreased as ambulatory activity level declined, and most of the disabled elderly people who could not move were not able to achieve most items. In the distributions of total scores of disabled elderly people, the frequencies distributed from 0 to perfect scores, and the cumulative relative frequency curves shifted gradually toward the right side (lower score range) in the order of D4 (independent immobile), D3 (using a wheelchair), D2 (using a stick or walker), and D1 (without assisting devices). These findings suggest that the ADL index used in present study can gradually assess from the near-bedridden elderly people who independent immobile to the independent elderly people, and that it can assess whether or not elderly people have the ADL ability required to live independently. Considering the ADL scores and achievement proportions, more difficult items may be necessary to assess individual differences of ADL ability of ID. However, it is suggested that this ADL index can also be applied

Table 5 Discriminant analysis of independent and disabled elderly groups

ADL domains	Item No.	Coefficients of discriminant function				Structure matrix			
		F1	F2	F3	F4	F1	F2	F3	F4
I Movement	1	0.452	0.496	-0.218	0.150	0.672	0.284	-0.305	-0.290
	2	0.136	-0.037	-0.538	-0.396	0.676	0.128	-0.314	-0.281
II Going up and down stairs	3	0.015	-0.140	0.329	0.263	0.603	-0.141	-0.025	0.031
III Changing and holding posture	4	-0.139	-0.247	-0.188	-0.645	0.358	0.068	0.009	-0.571
	5	-0.073	0.170	0.201	0.150	0.467	0.220	0.005	-0.389
	6	0.215	-0.046	-0.119	-0.100	0.601	-0.155	-0.094	-0.107
	7	0.097	0.152	0.158	0.216	0.296	0.303	0.236	0.154
	8	0.022	0.060	0.302	0.062	0.320	0.152	0.203	-0.040
IV Bathing	9	0.030	-0.061	-0.152	0.194	0.594	-0.049	-0.060	-0.072
	10	0.025	-0.091	-0.280	-0.039	0.634	-0.063	-0.140	-0.165
	11	0.091	-0.418	0.240	0.004	0.505	-0.140	0.251	-0.157
	12	-0.019	0.278	-0.136	0.069	0.459	0.066	0.178	-0.287
V Using the toilet	13	0.038	-0.176	0.236	-0.088	0.430	-0.055	0.242	-0.288
	14	-0.101	-0.143	0.161	-0.354	0.429	0.111	0.053	-0.555
	15	0.102	0.314	-0.095	0.076	0.510	0.330	0.088	-0.254
VI Dressing	16	-0.038	0.123	0.481	-0.313	0.321	0.259	0.490	-0.225
	17	-0.023	0.039	-0.028	0.128	0.534	-0.144	0.028	-0.063
	18	0.075	-0.014	0.008	-0.191	0.479	0.242	0.093	-0.331
	19	-0.181	0.076	-0.025	-0.165	0.435	0.164	0.221	-0.256
VII Grooming	20	0.467	-0.499	0.287	-0.027	0.581	-0.411	0.283	-0.218
	21	0.452	0.026	-0.139	0.261	0.469	0.340	0.162	0.096
	22	-0.159	0.021	-0.342	0.352	0.429	0.164	0.098	-0.119
VIII Eating	23	0.006	0.142	0.286	-0.343	0.288	0.381	0.469	-0.266
	24	0.019	0.103	0.277	0.437	0.347	0.295	0.405	0.145
IX Manual activity	25	0.092	0.242	-0.086	0.180	0.257	0.419	0.263	0.131
	26	-0.040	-0.164	-0.022	-0.117	0.391	0.065	0.322	-0.131
Age	27	-0.062	0.318	0.158	-0.043	0.271	0.253	0.297	-0.218
		-0.225	0.240	-0.071	-0.213	-0.319	0.295	-0.036	-0.183
<u>Mean of discriminant scores</u>						<u>Discriminant probability</u>			
Without assistance		-0.470	1.126	-0.740	-0.223	51.7			
Stick or walker		-1.942	0.900	0.937	0.292	64.3			
Wheelchair		-2.929	-1.134	0.133	-0.474	55.2			
Immobile		-2.984	-1.183	-1.313	1.104	65.7			
Independent older people		1.690	-0.271	0.086	0.027	94.5			
Total						76.2			

N.B. F1, F2, F3 and F4 indicate discriminant functions. Item No. corresponds to Table 2.

to assess ID in the sense that it can evaluate whether or not the functional level required to live independently is maintained, and it can recognize the symptoms of disability.

Another utility of this ADL index was examined in the sense of determining if it could discriminate the functional level of elderly people. While the probability of discriminating ID and disabled elderly groups was 94.5%, the probability of discriminating four disabled elderly groups was 70% in total. It is suggested that the low discriminating probability of disabled elderly groups was influenced by morbidity of various diseases and impairments^{1,14,15}. Furthermore, there were more items useful for discriminating the ID or D1 (without assisting devices) groups than there were for low ambulatory activity level groups, such as D3 (using a wheelchair) or D4 (independently immobile). Not only lower-limb activities, such as movement, but also upper-limb activities and basic activities are needed for independent living^{1,14,15}. Therefore, it is suggested that many items, including lower and upper limb

activities, are needed to discriminate ID. In the case of D1, it is suggested that they are inconvenienced regarding upper limb and manual activities^{1,14,15}. It is suggested that these D1 characteristics, relating to a few items concerning upper limb and manual activities, are useful for discrimination compared with ID. When discriminating the D3 (using a wheelchair) or D4 (independently immobile) groups, only a few basic and low-difficulty items were considered to be useful. With these groups, unlike ID, movement and lower-limb activities which most of them cannot achieve were not included as useful items. As stated above, in disabled elderly people, the factors influencing achievement of daily activities varied among individuals. Furthermore, in these elderly people, one of the reasons why only a few activities related to discrimination is that it was suggested to be difficult to indicate the constant trend in achievement characteristics¹. In any case, because the impairment and inconvenience characteristics of disabled elderly people were different, and the factors influencing ADL ability character-

Table 6 Discriminant analysis of disabled elderly groups

ADL domains	Item No.	Coefficients of discriminant function			Structure matrix		
		F1	F2	F3	F1	F2	F3
I Movement	1	0.637	0.076	-0.223	0.728	-0.278	0.242
	2	0.215	-0.583	0.304	0.654	-0.371	0.282
II Going up and down stairs	3	-0.177	0.319	-0.173	0.417	-0.218	0.115
III Changing and holdong posture	4	-0.361	-0.297	0.619	0.323	-0.051	0.588
	5	0.125	0.199	-0.158	0.492	0.005	0.390
	6	0.218	-0.150	0.165	0.412	-0.306	0.253
	7	0.162	0.219	-0.178	0.350	0.289	-0.110
	8	0.051	0.315	0.031	0.315	0.207	0.103
	9	0.012	-0.232	-0.167	0.449	-0.194	0.178
IV Bathing	10	0.040	-0.327	0.022	0.475	-0.287	0.259
	11	-0.216	-0.003	0.176	0.241	0.079	0.324
	12	0.259	-0.050	-0.110	0.356	0.101	0.368
	13	-0.073	0.112	0.172	0.245	0.110	0.407
V Using the toilet	14	-0.216	0.157	0.307	0.384	-0.002	0.567
	15	0.277	-0.002	-0.134	0.569	0.127	0.257
	16	-0.009	0.454	0.364	0.338	0.493	0.313
VI Dressing	17	-0.025	-0.053	-0.101	0.355	-0.158	0.231
	18	0.060	-0.009	0.141	0.496	0.095	0.348
	19	-0.018	0.069	0.071	0.389	0.185	0.315
	20	0.014	0.033	0.262	0.112	-0.027	0.472
VII Grooming	21	0.247	-0.184	-0.241	0.490	0.208	-0.057
	22	-0.096	-0.207	-0.433	0.397	0.084	0.160
	23	0.058	0.250	0.349	0.383	0.508	0.300
VIII Eating	24	-0.043	0.319	-0.406	0.362	0.428	-0.057
	25	0.310	0.022	-0.179	0.412	0.382	-0.122
IX Manual activity	26	-0.155	-0.085	0.158	0.277	0.247	0.240
	27	0.169	0.271	-0.013	0.318	0.317	0.250
Age		-0.024	0.086	0.071	-0.026	0.178	0.057
<u>Mean of discriminant scores</u>					<u>Discriminant probability</u>		
Without assistance		1.257	-0.374	0.087	79.5		
Stick or walker		0.033	0.921	-0.205	67.8		
Wheelchair		-1.392	-0.135	0.406	66.7		
Immobile		-1.355	-1.007	-0.919	60.0		
Total					71.2		

N.B. F1, F2 and F3 indicate discriminant functions. Item No. corresponds to Table 2.

istics varied among individuals, it is important to comprehensively assess ADL ability for disabled elderly people. It is difficult to discriminate the functional level of disabled elderly people using only a few specific activities. However, the activities considered useful for discrimination become important tools to recognize the functional level of disabled elderly people. It is expected that useful utilization of these activities will contribute to more convenient and efficient functional assessment of elderly people.

In summary, the findings of present study suggested that this ADL index can gradually assess from disabled elderly people who

cannot move to independent elderly people. Since this index classifies independent elderly people and disabled elderly people with high probability, it can evaluate whether elderly people maintain the functional level required for independent living, and can recognize the symptoms of disability. Furthermore, this study proposes useful activities to discriminate the functional level for each elderly group. Although it is important to comprehensively assess ADL ability, it is expected to advance other utilities of this ADL index to discriminate the functional level of the elderly population, by making use of these useful activities.

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