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Longitudinal Assessment of ADL Ability of Partially Dependent Elderly People: Examining the Utility of the Index and Characteristics of Longitudinal Change in ADL Ability

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Abstract The present study aimed to evaluate the utility of the activities of daily living (ADL) index for partially dependent elderly people (ADL-PDI) when applied longitudinally to an institutionalized partially dependent (PD) group, and to determine the characteristics of the longitudinal change in ADL ability of the PD group. The subjects were ten Japanese PD living at welfare institutions for the aged such as accredited nursing homes and health facilities (mean age was 82.2 ± 2.32 years in total; 84.3 ± 4.18 years for five males; 80.3 ± 2.33 years for five females). The questionnaire consisted of the ADL-PDI, the Barthel index (BI), physical independence, dementia independence, anamnesis, body impairments, use of assisting devices, the institutionalized period, and type of medical rehabilitation and medical treatment, and was administered to the subjects twice during their institutionalized period. All testers were staff working at the subjects' institution, such as occupational therapists, physiotherapists and nurses. The result of the longitudinal ADL assessment was that ADL-PDI may evaluate the longitudinal change in ADL ability on a unidimensional scale. The utility of the standard for discriminating the functional level of the elderly using the ADL-PDI score, which was indicated in our previous study (Sato et al., 2001), was supported by longitudinal data. Furthermore, the BI was superior to the ADL-PDI in evaluating the disabled elderly with lower functional levels. However, the ADL-PDI was better than the BI in evaluating the disabled elderly with a higher functional level and was considered to have wider applications in evaluating the ADL ability of the elderly. *J Physiol Anthropol 21 (4): 179-187, 2002* http://www.jstage.jst.go.jp/en/

Keywords: ADL, longitudinal assessment, dependent elderly people, unidimensional scale

Introduction

With an advancing aging society, physical functional assessment of elderly people is increasingly important in the field of physical rehabilitation. It is important to obtain accurate information on physical function and health status, and recognize the symptoms of disability or an improving functional level through periodic physical functional assessments of the elderly.

In the classification of the elderly population into three groups of bedridden (BED), partially dependent (PD) and independent living (IL) groups based on functional level, the PD group has the possibility of their functional level decreasing to bedridden, or, if their functional level improves, to become independent living (Sato et al., 2001). This means that evaluating the functional characteristics of the PD can propose meaningful information on the process of disability from an independent to bedridden level, and of functional improvement.

We developed an ADL index for the PD (ADL-PDI; Demura et al., 1999; Sato et al., 1999), consisting of 17 items, based on theoretical and empirical examination, to determine unidimensionality of the scale (Demura et al., 1999). Because of the unidimensionality of the scale, this index has the advantage such that the functional level of the elderly population, such as BED, PD and IL, may be screened using the evaluations of this ADL index (Sato et al., 2001). If this index can reflect a change in functional characteristics when applied periodically and if it can

Table 1 ADL items selected in the present study

ADL domains	No.	ADL items	Contents of each ADL item
I	1	Tossing about in bed	Can toss about in bed without assistance.
Changing and	2	Sitting up from a lying posture	Can change posture from lying to sitting.
holding	3	Standing up from a sitting posture	Can change posture from sitting to standing without hanging on to something.
the posture	4	Holding standing posture	Can hold standing posture without assistance for one minute*.
II	5	Putting on a shirt over the head	Can put on a shirt over the head within about thirty seconds*.
Dressing	6	Putting on slacks	Can put on slacks while standing.
	7	Putting on trousers (buttons, belt)	Can put on trousers including button, belt, and within one to two minutes*.
III	8	Using the toilet (Western style)	Can use a Western-style toilet without assistance.
Toiletting	9	Going to the toilet	Can go to and use a Western-style toilet without assistance.
IV	10	Washing the whole body	Can wash the whole body without assistance.
Bathing	11	Entering the bathtub	Can straddle the bathtub and go inside without assistance.
V	12	Feeding	Can eat something small such as a bean using chopsticks.
Manual activities	13	Writing	Can write by hand in normal size.
VI	14	Walking	Can walk without a self-help device.
Walking	15	Ascend and descend stairs	Can go up and down stairs one step at a time without hanging on to a handrail.
VII	16	Carrying objects	Can carry relatively light things such as a piece of clothing, a garden plant, or a pan.
Movement and carrying	17	Range of activity	Can go for a walk in the neighborhood.

The subject being tested responded "possible" or "impossible" to the above-stated questions. *: The times were determined based on the results of survey for occupational therapists.

recognize symptoms of the decrease or improvement of ADL ability they are important considerations regarding the utility of this index. However, since this index has an advantage when using cross-sectional data, evaluating, if this advantage is also determined by longitudinal data, is necessary to propose the utility of this index. This study aimed to evaluate the utility of the ADL-PDI when applied longitudinally to the institutionalized PD, on admission to and discharge from the institution, and to determine the characteristics of the longitudinal change in ADL ability of the PD.

Methods

Subjects

The subjects were ten Japanese PD elderly people living at welfare institutions for the aged such as accredited nursing homes and health facilities (mean age was 82.2 ± 2.32 years in total; 84.3 ± 4.18 years for five males; 80.3 ± 2.33 years for five females). The number of subjects in each gender and age group were as follows: one in the 60s (male = 1, female = 0), three in the 70s (male = 2, female = 1), five in the 80s (male = 2, female = 3) and one in the 90s (male = 0, female = 1). In the first ADL assessment, all subjects were ranked A or B on the standard for the degree of independence for disabled elderly people, approved by the Japan Ministry of Health and Welfare (JMHW) in 1991. This standard consists of four categories of rank A (house-bound: needing partial assistance only in outdoor activities), B (chair-bound: needing partial assistance only in indoor activities), C (bed-bound: dependent for most daily activities) and J (independent in daily life activities). This standard is generally used in welfare institutions in Japan. Eight subjects were taking periodic rehabilitation from the staff working at their institution. Two did not take rehabilitation and were taking daily medical treatment.

Data collection

Prior to the survey, informed consent from the subjects was obtained via institutional staff. Each subject was assessed twice by the same tester during the institutionalized period. Since the health facility was a short-term institution, two assessments were conducted, on admission to and discharge from the institution. The mean period from the baseline to the second assessment was 63.4 ± 41.4 days (31 to 133 days). All testers were staff working at the subjects' institutions, such as occupational therapists, physiotherapists and nurses.

Questionnaires

An ADL-PDI developed in our previous studies (Demura et al., 1999, Sato et al., 2001) and the Barthel index (BI) were used in the ADL assessment. The ADL-PDI consists of 17 ADL items selected from seven ADL domains of 1) changing and holding posture, 2) dressing, 3) toileting, 4) walking, 5) bathing, 6) manual activities and 7) movement, and is assessed on a dichotomous scale of "possible" or "impossible" (Table 1). Reliability, validity and unidimensionality of the scale were previously confirmed (Demura et al., 1999) with inter- and intra-reliabilities of r=0.940 and r=0.996,

respectively.

The BI has ten items with a polychotomous scale as follows: feeding (10 = independent, 5 = with help, 0 = impossible), moving from a wheelchair to bed and return including sitting up in bed (15 = independent, 10 or 5 = with help, 0 = impossible), personal toilet such as washing the face, combing the hair, shaving, cleaning teeth (5 = independent, 0 = impossible), getting on and off the toilet including handling clothes, wiping, flushing (10=independent, 5=with help, 0 = impossible), bathing self (5 = independent, 0 = impossible), walking on a level surface or if unable to walk, propelling a wheelchair (15 = independent, 10 = with help, 5 = using a wheelchair, 0 = impossible), ascending and descending stairs (10 = independent, 5 = with help, 0 = impossible), and dressing including tying shoes, fastening fasteners (10 = independent, 5 = with help), controlling bowel (10 = independent, 5 = with help) and controlling bladder (10 = independent, 5 = with help, 0 = impossible). The total BI score when summed ranges from zero (total dependence) to 100 (complete independence). This index has been examined for reliability and validity in various studies (Mahony et al., 1965; Granger et al., 1979), and is generally used in most welfare institutions.

Physical independence, dementia independence, anamnesis, body impairments, use of assisting devices, the institutionalized period, medical rehabilitation and treatment (aim, frequency) were examined in addition to the ADL assessment. Physical independence was evaluated using the above-mentioned standard for the degree of independence for disabled elderly people approved by the JMHW in 1991. Dementia independence was assessed by the degree of independence for demented elderly people approved by JMHW in 1993. This standard ranks dementia independence in five categories, I: independent level in almost all daily activities in the community; II: independent level but needing some attention; III: needs attendant care; IV: needs attendant care all the time; M: needs medical treatment.

Evaluation of the utility of the ADL-PDI

This study evaluated the utility of the ADL-PDI from the following points. First, whether the ADL-PDI can assess ADL ability of the PD based on unidimensionality of the scale was evaluated. In our previous study, unidimensionality based on difficulty of activity was confirmed among 17 ADL items consisting of the ADL-PDI. The difficulty-ordering among 17 activities is shown in Table 3. The easiest activity is "feeding", and the hardest activity is "ascending and descending stairs". If this difficulty-ordering is a perfect unidimensional scale, the subject can achieve these activities in difficulty-order. Therefore, this study evaluated whether ADL-PDI can assess the longitudinal change in ADL ability characteristics based on this unidimensional scale, by comparing between pre- and post-assessments.

Our previous study indicated that the possibility of falling into a bedridden situation increases when the total score of the ADL-PDI is 5 or less, and that four easier activities, such as "feeding", "going to the toilet", "tossing about in bed" and "writing", are useful in determining if the PD is becoming bedridden. In addition, it was pointed out that the functional level is close to independent living when the total score is 13 or more, and that five more difficult activities, such as "putting on slacks", "putting on trousers", "standing up from a sitting posture", "ascending and descending stairs" and "washing the whole body", are useful in determining if the PD is becoming independent living (Sato et al., 2001). Secondly, this study evaluated the utility of these standards from the relationship between longitudinal changes in ADL ability characteristics and physical functional levels assessed by the standard for the degree of independence for disabled older people by JMHW.

Thirdly, the relationship between ADL-PDI and BI and the relationship between physical independency and ADL scores in both indexes were calculated for pre- and post-assessment scores, and their differences were assessed with Spearman's order correlations. When determining the correlation between physical independence and ADL scores, physical independence was changed into numerical value ranks as follows: J=4, A=3, B=2, C=1. Furthermore, the longitudinal changes in ADL scores, (pre-assessment - post-assessment)/total score, were calculated according to the subjects who indicated a decrease in ADL ability and those who indicated an improvement in ADL ability.

Results

Tables 2 and 3 show the profile of each subject and the results of the pre- and post-assessments using the ADL-PDI and the BI, respectively.

Subjects 1, 2 and 3 were admitted to the health facility from a hospital. Their health status took a turn for the worse and they returned to the hospital. On admission, they had lower extremity functional rehabilitation three or four times a week for 30 minutes a day, but they could not do this on discharge. They did not use an assisting device on admission, but used a wheelchair on discharge. Their physical independence rank declined from A (house-bound) to C (bed-bound). Their ADL-PDI scores also declined as follows: Subject 1: 4 to 1; Subject 2: 7 to 1; and Subject 3: 4 to 1. On admission, all the three subjects could move indoors, and could also perform the activities of "sitting up from a lying posture", "standing up from a sitting posture", and "holding a standing posture". On discharge, however, the only activity that they could do was "tossing about in bed". In the BI score, decreases

Table 2 Profile of each subject

Contents	Subject 1	Subject 2
Age	76 years old	81 years old
Gender	Male	Female
Institutionalized period	31 days	46 days
Physical independency	Rank A → Rank C	Rank A → Rank C
Senile dementia independency	Rank M → Rank M	Rank III → Rank III
Anamnesis	Cerebrovascular disorder, cardiac disease, respiratory disease, skin disease (decubitus; at discharge)	Cerebrovascular disorder, cardiac disease, diabetes mellitus
Body impairments	Upper and lower extremities	Lower extremity
Use of assisting device	Wheelchair → Wheelchair	Unnecessary → Wheelchair
Situation at admission and discharge	Admitted to health facility from hospital Return to hospital, because decubitus operation	Admitted to health facility from hospital Returned to hospital.
Medical rehabilitation	Medical rehabilitation training for lower extremity and mobility function (frequency: 3 to 4 days/week, 30 minutes/day) *Training could not be conducted at discharge because he took a turn for the worse.	Medical rehabilitation training for lower extremity and mobility function (frequency: 3 to 4 days/week, 30 minutes/day) *Training could not be conducted at discharge because she took a turn for the worse.

Contents	Subject 3	Subject 4
Age	89 years old	84 years old
Gender	Male	Female
Institutionalized period	31 days	31 days
Physical independency	Rank A → Rank C	Rank A → Rank A
Senile dementia independency	Rank III → Rank III	Rank III → Rank III
Anamnesis	Cerebrovascular disorder, diabetes mellitus, bone disorder	Cerebrovascular disorder, cardiac disease
Body impairments	Lower extremity, eye, ear	Eye, heart (use of a pacemaker)
Use of assisting device	Unnecessary → Wheelchair	Unnecessary → Unnecessary
Situation at admission and discharge	Admitted to health facility from hospital Returned to hospital.	Admitted to health facility from hospital. Went home after discharge
Medical rehabilitation	Medical rehabilitation training for lower extremity and mobility function (frequency: 3 to 4 days/week, 30 minutes/day) *Training could not be conducted at discharge because he took a turn for the worse.	Mobility training, every day, 30 minutes/day

Contents	Subject 5	Subject 6
Age	76 years old	88 years old
Gender	Female	Male
Institutionalized period	34 days	68 days
Physical independency	Rank A → Rank A	Rank A → Rank A
Senile dementia independency	Rank III → Rank III	Rank I → Rank I
Anamnesis	Dementia	Bone disorder
Body impairments		The waist
Use of assisting device	Unnecessary → Unnecessary	Unnecessary → Unnecessary
Situation at admission and discharge	Admitted to health facility from hospital Went home after discharge	Admitted to health facility from hospital Went to home after discharge
Medical rehabilitation	Mobility training, every day, 30 minutes/day	Mobility training, every day, 30 minutes/day

between pre- and post-assessments were found in "getting on and off toilet" in Subject 1, all activities except for "ascending and descending stairs" in Subject 2 and "ascending and descending stairs", "controlling bowel" and "controlling bladder" in Subject 3.

Subjects 4, 5 and 6 were institutionalized in a health facility for 31, 34 and 68 days, respectively, and they were taking mobility training. Their ADL scores were more than 13 in ADL-PDI, and more than 90 in BI. Despite continuous and regular mobility training, their ADL

Table 2 Profile of each subject (continue)

Contents	Subject 7	Subject 8
Age	88 years old	95 years old
Gender	Female	Female
Institutionalized period	128 days	34 days
Physical independency	Rank A → Rank J	Rank B → Rank B
Senile dementia independency	Rank III → Rank II	Rank III → Rank II
Anamnesis	Skin disease, eye disease	Nothing
Body impairments	Ear	Waist
Use of assisting device	Unnecessary → Unnecessary	Wheelchair → Wheelchair
Situation at admission and discharge	Admitted to accredited nursing home from hospital Went home after discharge	Admitted to accredited nursing home from hospital Went home after discharge
Medical rehabilitation	Nothing	Mobility training, 1 to 2 days/week, 30 minutes/day

Contents	Subject 9	Subject 10
Age	73 years old	66 years
Gender	Male	Male
Institutionalized period	98 days	133 days
Physical independency	Rank B → Rank B	Rank A → Rank A
Senile dementia independency	Rank II → Rank II	Rank I
Anamnesis	Cerebrovascular disorder, articular disorder, paralyses of extremities	Skin disease, paralysis
Body impairments	Lower extremity, eye	Upper and lower extremities
Use of assisting device	Wheelchair → Wheelchair	Wheelchair → Wheelchair
Situation at admission and discharge	Admitted to accredited nursing home from hospital Went home after discharge	Admitted to health facility from hospital Went home after discharge
Medical rehabilitation	Nothing	Mobility training and upper extremity medical training, 3 to 4 days/week, 60 minutes/day

" → " means the change of status from pre- and post-assessment. Ranks of physical independency were as follows: Rank A (house-bound), B (chair-bound), C (bed-bound) and J (independent living). Ranks of senile dementia independency were as followed; Rank I (independent level in almost all daily activities in the community), II (independent level but needing some attention), III (needs attendant care), IV (needs attendant care all the time), M (needs medical treatment).

evaluations did not change between pre- and post-assessments in both indexes.

Subjects 7, 8 and 9 were institutionalized in an accredited nursing home from a hospital, and Subject 10 was in a health facility from a hospital. All four subjects went home after discharge. Their ADL-PDI scores increased between pre- and post-assessment (Subject 7: 12 to 17; Subject 8: 3 to 6; Subject 9: 6 to 11; and Subject 10: 7 to 8). Subject 8 (95 years old) and Subject 10 (66 years old) periodically took mobility training and upper extremity functional rehabilitation. At post-assessment, their lower extremity functional level improved, and they could perform activities such as "going to the toilet", "standing up from a sitting posture", and "putting on slacks". Although Subjects 7 (88 years old) and 9 (73 years old) were only taking medical treatment at the institution, they could perform activities of movement, upper extremity activities and dressing with a standing posture. Similarly, increases in the BI scores were also found in "moving from wheelchair to bed" and "personal toilet" in Subject 8, "feeding" in Subject 9, and "personal toilet" and "bathing" in Subject 10, but a decrease was found in "dressing" in Subject 10.

Table 4 compares the characteristics of ADL evaluations between the ADL-PDI and BI indexes. Spearman's order correlations between the ADL-PDI and BI scores were 0.826 at pre-assessment, 0.950 at post-assessment and 0.844 for the differences in ADL scores between pre- and post-assessments. These correlations were significantly high. Spearman's order correlations between physical independency and both ADL indexes scores at pre-assessment, post-assessment and the differences between pre- and post-assessments were 0.527, 0.857 and 0.865 for ADL-PDI, and 0.405, 0.882, 0.678 for BI. These correlations in both indexes were significant except for the pre-assessment values. Furthermore, the longitudinal changes in ADL scores were calculated for subjects indicating a decrease of ADL score (Subjects 1, 2 and 3), and for subjects indicating an improvement of ADL score (Subject 7, 8, 9 and 10). The mean values of longitudinal changes for the subjects showing a decrease were 23.5% for ADL-PDI and 40% for

Table 3 Change of ADL evaluation between pre- and post-assessment

ADL-PDI Ordering*	ADL items	Subject 1		Subject 2		Subject 3		Subject 4		Subject 5		Subject 6		Subject 7		Subject 8		Subject 9		Subject 10	
		pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
1	Ascend and descend stairs	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×	×	×	×
2	Putting on slacks	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×	○	×	○
3	Putting on trousers	×	×	×	×	×	×	○	○	○	○	○	○	×	○	×	×	×	○	×	×
4	Sitting → standing posture	○	×	○	×	○	×	○	○	○	○	○	○	○	○	×	○	×	×	×	×
5	Washing the whole body	×	×	×	×	×	×	○	○	○	○	○	○	○	○	×	×	×	×	×	×
6	Range of activity	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×	×	○	○
7	Carrying objects	×	×	×	×	×	×	○	○	○	○	○	○	○	○	×	×	×	○	×	×
8	Walking	×	×	○	×	×	×	○	○	○	○	○	○	○	○	×	×	×	×	×	×
9	Entering the bathtub	×	×	×	×	×	×	×	×	○	○	×	×	○	○	×	×	×	○	×	×
10	Putting on a shirt	×	×	×	×	×	×	○	○	○	○	○	○	×	○	×	×	×	○	○	○
11	Holding standing posture	○	×	○	×	○	×	○	○	○	○	○	○	○	○	×	×	×	×	×	×
12	Using the toilet	×	×	○	×	×	×	○	○	○	○	○	○	○	○	×	○	○	○	○	○
13	Writing	×	×	×	×	×	×	○	○	○	○	○	○	○	○	×	×	○	○	×	×
14	Lying → sitting posture	○	×	○	×	○	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○
15	Tossing about in bed	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
16	Going to the toilet	×	×	×	×	×	×	○	○	○	○	○	○	○	○	×	○	○	○	○	○
17	Feeding	×	×	○	×	×	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Total score	4	1	7	1	4	1	13	13	14	14	13	13	12	17	3	6	6	11	7	8
	Feeding	△	△	○	△	○	△	○	○	○	○	○	○	○	○	○	○	△	○	○	○
	Moving from wheelchair to bed	△	△	○	×	○	×	○	○	○	○	○	○	○	○	△	○	○	○	○	○
	Personal toilet	×	×	×	×	×	×	○	○	○	○	○	○	○	○	×	○	○	○	×	○
	Getting on and off toilet	△	×	△	×	△	×	○	○	○	○	○	○	○	○	△	△	○	○	○	○
BI	Bathing self	×	×	△	×	△	×	△	△	○	○	△	△	○	○	×	×	△	△	×	△
	Walking on level surface	▲	▲	△	×	△	×	○	○	○	○	○	○	○	○	×	×	▲	▲	▲	▲
	Ascend and descend stairs	×	×	×	×	×	×	△	△	△	△	△	△	○	○	×	×	×	×	×	×
	Dressing	△	△	△	×	△	×	○	○	○	○	○	○	○	○	×	×	△	△	○	△
	Controlling bowels	×	×	○	×	○	○	○	○	○	○	○	○	○	○	×	×	○	○	○	○
	Controlling bladder	×	×	△	×	△	△	○	○	△	△	○	○	○	○	△	△	○	○	○	○
	Total score	25	20	70	5	70	20	95	95	90	90	95	95	100	100	30	40	70	75	70	75

*: Items of ADL-PDI were indicated based on difficulty-ordering guaranteed unidimensional scale in previous study (Demura et al., 1999). ○ : Independent (possible), △ : with help, ▲ : Using wheelchair, × : dependent (impossible).

Table 4 The comparison of the ADL score characteristics between ADL-PDI and BI

Relationship in ADL scores between ADL-PDI and BI			
	pre-test	0.826	**
	post-test	0.950	**
	differences	0.844	**
Relationship in the amounts of change between the PI and both ADL indexes			
ADL-PDI	pre-test	0.527	ns
	post-test	0.857	**
	differences	0.865	**
BI	pre-test	0.405	ns
	post-test	0.882	**
	differences	0.678	*

The amount of change was pre-test minus post-test score. PI means Physical independency: Rank J=4 to Rank C=1. The above correlations were calculated by Spearman's order correlations. **: p<0.01, *: p<0.05, ns: not significant.

BI, and longitudinal changes for the subjects showing an improvement were 20.6% for ADL-PDI and 5% for BI.

Discussion

Health facilities for the elderly provide attendant care, medical treatment and training for activities of daily living for the weak elderly with a stable physical state, and generally provide short-term institutional care from a week to some months. Accredited nursing homes for the elderly provide nursing care to bedfast people over 65 years of age. This is not a short-term institution, but it provides attendant care, medical treatment and training for functions required in daily life for institutionalized elderly requiring nursing care. This study investigated the characteristics of longitudinal change in ADL ability between pre- and post-assessments during institutionalization. Throughout this examination, the utility of the ADL-PDI was evaluated. This section discusses each case showing a change/no change in ADL

ability characteristics.

Firstly, whether the ADL-PDI can assess ADL ability of the PD was evaluated based on unidimensionality of the scale. In the relationship between total score of the ADL-PDI and the type of activities achieved independently, there were cases where an achievement pattern was not necessary to reflect a unidimensional scale in activities such as "changing posture from a sitting to standing position" in Subjects 1, 2 and 3, and "entering the bathtub" for Subjects 5 and 6. It is considered that this is influenced by individual differences in characteristics of functional diseases. In general, however, there was a tendency to reflect a unidimensional scale. In other words, there were trends where a person with a low score could achieve only less difficult activities (Subjects 1, 2, 3 and 8), and a person with a high score could achieve highly difficult activities (Subjects 4, 5, 6 and 7). For Subjects 7, 8, 9 and 10 whose total scores increased, it is considered that an improved physical function necessary for daily life made it possible to achieve highly difficult activities. Furthermore, a longitudinal change in ADL ability tended to indicate that subjects with an increased total score could achieve more difficult activities, and that subjects with a decreased total score could not achieve more difficult activities on the scale. These results indicate that the ADL-PDI can assess the change in ADL ability characteristics of disabled elderly people on a unidimensional scale.

Secondly, the utility of standards for discriminating functional levels of bedridden or independent older people by ADL-PDI scores was suggested in our previous study (Sato et al., 2001) and was evaluated. Among the subjects with a total score of 5 or less at pre-assessment, Subjects 1 and 3 could not independently achieve "feeding" and "going to the toilet", which were included in four less difficult activities, at pre-assessment, and they could not achieve any activities excepting "tossing about in bed" in post-assessment. Similarly, their physical independency rank fell from A (house-bound) to C (bed-bound). In addition, among the subjects with a total score of 13 or more at pre-assessment, Subject 7 could achieve "washing the whole body" and "standing from a sitting posture", which were included in five high-difficulty activities, at pre-assessment, and then could achieve all activities independently at post-assessment. Her physical independency rank also rose from A to J (independent living). These results support the utility of these standards for discriminating the functional level of older people. The ADL-PDI total score of Subject 2 was 7 at pre-assessment, but it remarkably decreased to 1 at post-assessment. As functional ability of older people is reported to decline remarkably in the short term, continuous assessments are important in ADL assessments of the elderly.

Thirdly, the evaluations by ADL-PDI and BI were compared to determine the characteristics of evaluations of these indexes. Comparing the characteristics of these two indexes, the BI consists only of basic activities in daily life, while the ADL-PDI includes more difficult activities such as "carrying objects" and "range of activity". In this study, the relationships between both ADL scores were high at pre- and post-assessment scores, and the differences between pre- and post-assessments. Additionally, both ADL indexes also indicated a significant relationship to physical independency except for the pre-assessment score. These findings suggest that evaluations of both ADL indexes for disabled elderly are interrelated. Since BI is an ADL scale that has had its reliability and validity examined in various studies, these findings may be one piece of evidence indicating the utility of the ADL-PDI. Although the relationships between physical independency and ADL evaluations at pre-assessment were not significant in both indexes, this finding should be further investigated with large samples.

In addition, the longitudinal change in ADL scores was greater for BI (40%) than ADL-PDI (23.5%) in assessments of subjects showing a decrease in ADL score, and was greater for ADL-PDI (20.6%) than BI (5%) in assessments of subjects showing an improvement in ADL score. Subjects showing a decrease (Subjects 1, 2 and 3) tended to be at a lower functional level. Their ADL-PDI scores were all 1 at discharge, and they could achieve only "tossing about in bed". In the results of the BI, Subjects 1 and 3 were categorized as "with help" according to activities of "feeding", "moving from wheelchair to bed", "walking on a level surface", "dressing", "controlling bowel" and "controlling bladder" at discharge. From these findings, BI is superior to ADL-PDI in evaluating the disabled elderly with lower functional levels because it evaluates basic activities in daily life with a polychotomous scale (three or four point scales). In contrast, subjects showing an improvement (Subjects 7, 8, 9 and 10) tended to have a high functional level. For Subjects 7 and 8, the BI could not reflect their change in ADL ability, unless their ADL-PDI scores improved (Subject 7: 12 to 17 points; Subject 9: 6 to 11 points). Namely, in the BI, a ceiling effect was found in an ADL assessment for disabled elderly with relatively high functional levels. Therefore, the ADL-PDI is superior to the BI in evaluating the disabled elderly with a higher functional level since ADL-PDI can be applied to the elderly with a wide functional level range because it includes activities with various difficulties, and this index can sensitively reflect the change in ADL ability characteristics.

Furthermore, in previous studies (Kono and Kanagawa, 1999; Fries et al., 2000), it was reported that the ADL ability of elderly people decreases with aging, and that the decrease is remarkable in people over 95 years old. In contrast, some good influences such as delaying disability

and functional improvement were reported in previous longitudinal studies investigating the influence of periodic rehabilitation for four to twelve months on the functional characteristics of institutionalized elderly people (Mulrou et al., 1993; Phillips et al., 1997; Blair, 1999; Morris et al., 1999; Fortinsky et al., 1999). In the present study, an improved ADL ability was recognized in the 70s to the 90s age group. In particular, the ADL ability of Subjects 7 (88 years old) and 8 (95 years old) improved compared with those at the first assessment unless they were over 85 years old. These findings indicate the possibility that ADL ability is improved even with disabled elderly people at a lower functional level. With Subjects 4, 5 and 6 whose ADL evaluation did not change, their institutionalized terms, from 31 to 68 days, were short compared to the four people recognized with an improved ADL evaluation. This points to the possibility that an ADL evaluation improves if institutionalized terms are longer. The results of the present and previous studies indicate that there is a possibility of improvement or a delay in the decrease in ADL ability of elderly people by rehabilitation, and suggests examining more proper rehabilitation programs and methods to estimate the change of functional characteristics (MacRae et al., 1996; Blair, 1999; Wu et al., 2000).

In conclusion, the ADL-PDI can assess the longitudinal change in ADL ability on a unidimensional scale, where a decline of ADL ability is caused by various diseases and improvements are a result of various rehabilitation and medical treatments. The utility of the standards for discriminating functional level of older population by ADL-PDI scores, which were indicated in a previous study, was also supported in a longitudinal ADL assessment. The ADL-PDI has wide applications for older people with various functional levels compared to BI. In addition, an improved ADL function was found even in more aged disabled people, and the importance of continuous ADL assessments and the necessity of examining more proper rehabilitation programs were suggested.

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