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Development and review of the validity of an “instrumental activities of daily living test” (IADL test) performed as a desk evaluation of patients with Alzheimer’s type of dementia

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Abstract

The instrumental activities of daily living scale (IADL scale) for Alzheimer’s type of dementia (ATD) does not provide a simple and easy way for evaluators to directly evaluate the targeted individuals. Therefore, we developed an experimental method, which allows a desk evaluation of IADL (on-the-desk evaluation of IADL). The study involved a group of 24 subjects with normal control (MMSE, 28.9 ± 1.4) and a group of 21 subjects with ATD (MMSE, 19.8 ± 4.4). The desk evaluation of IADL involved 9 tasks, which included boiling water with an electric kettle, pulling the plug out of the outlet once the water boils, and making a telephone call. For the test, the subjects were instructed to figure out by themselves the sequence in which they would perform the tasks. The scoring was performed on the basis of the appropriateness or inappropriateness of their behavior in each task and the time it took them to complete each task. The maximum score was set to a total of 59 points. Additionally, in order to examine the validity of the test and the factors which may affect the desk assessment of IADL, various types of neuropsychological tests were performed. The IADL Scale and the Frenchay Activities Index (FAI) were used in the evaluation of IADL. The results showed significant difference in the scores between the 2 groups. The at-the-desk evaluation of IADL revealed a strong correlation between the IADL Scale and the FAI ($r=0.89$, $r=0.82$, $p<0.001$), and a multiple regression analysis of the IADL scores from the desk evaluation showed a high explanation rate ($R^2=0.84$) by “the Behavioural Assessment of the Dysexecutive Syndrome,” “the Wechsler Memory Scale-Revised/digit span backwards test,” the “Rivermead Behavioural Memory Test/appointment”, “Composing task”. The high correlation between the desk evaluation of IADL and the IADL evaluation scale and the results of the multiple regression analysis indicated that the desk evaluation of IADL reflected cognitive functions in ATD and was highly reliable and valid.

Key words

Qualitative evaluation, IADL, Alzheimer’s type of dementia, Review of the validity

Introduction

With the development in recent pharmacological medical treatments, the importance of the role of preventative medical care for Alzheimer’s of type

dementia (ATD) has increased [1].

Interventions to prevent dementia have also been started for elderly people living at home, including those who are in good health and those

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at the prodromal stage of ATD, which is also known as “mild cognitive impairment” (MCI). The revised edition of the *Ninchisho-Yobo-Shien-Manyuaru* (the manual for the prevention of dementia and support for dementia patients) published by the Health, Labor and Welfare Ministry (2009) [2] states the importance of preventive interventions in the presence of cognitive impairments represented by three early symptoms of ATD: decline in divided attention, decreased memory, and decreased executive functions. The Ministry recommends that executive functions in particular should be evaluated on the basis of performance in instrumental activities of daily living (IADL), and should be approached through preventive nursing care.

The IADL is included among the tools for evaluating executive functions and is therefore important in preventive nursing care.

In addition, in previous reports on IADL performance, for example, those by Douglas et al. and Hanaki et al., who used Alzheimer’s disease cooperative study-activities of daily living (ADCS-ADL) and the Frenchay Activities Index (FAI), respectively, found a significant decrease in the scores [3] [4] in common among IADL items such as “organizing tasks,” “clean-up tasks,” “money management,” and “carrying out one’s promise” from the early stages of ATD. For that reason, the IADL has been the focus of attention as an aid to the diagnosis of dementia.

Nowadays, the evaluation of IADL is actually conducted by families who know well how the subjects conduct their IADL and who give scores by asking questions based on the items include in the IADL Evaluation Scale.

However, because the IADL evaluation scale does not involve direct observation of the study subjects’ behavior by public health and healthcare professionals, it might not be possible to carry out qualitative evaluations. Alternatively, the same scores could be attributed to different individuals based on the IADL Scale, even in the presence of different behavioral disorders. Regarding the relationship between IADL and higher brain function disorders, Meguro stated that IADL is

related to executive functions [5], and Nakaaki et al. indicated that prospective memory and IADL are strongly related [6].

Although a method known as the assessment of motor and process skills (AMPS) allows a direct qualitative evaluation of IADL, AMPS is not specific to the evaluation of executive functions and prospective memory.

Because of this gap, it is necessary to develop an IADL evaluation tool that clearly reflects the initial symptoms in ATD patients and that will allow evaluators to directly evaluate the IADL and the status of executive functions through simple observation. Therefore, using as models the six-parameter test of the executive functions of ATD patients in a three-square-meter room, as reported by Shallice et al. [7], and the hotel task used by Manly et al. [8], we developed the Validity of a Clearing up Test, which is composed of multiple tasks, and in which all tasks have to be conducted and a time is established. We also examined the test’s relationship to the behavioral assessment of the dysexecutive syndrome (BADS) [9]. The results showed a correlation with the BADS scores [10]. However, in order to make it easy to evaluate the IADL through the Clearing Up Test, improvements were needed so that the evaluation could be performed at the desk. Further study was necessary to assess the test’s relationship to tests for depression and to neuropsychological tests other than BADS.

Therefore, the purpose of this study is to develop an IADL test practicable at the desk (hereinafter referred to as the At-the-Desk IADL Test) for patients in the early phase of ATD and to examine the reliability and validity and the factors that have an influence on the At-the-Desk IADL test.

Methods

1. The study subjects

1) The ATD group

The criteria for the selection of study subjects in the ATD group were that they (a) had been diagnosed by physicians according to the DSM-III-R (diagnostic and statistical manual of mental

Table 1. Characteristics of the subjects

	NC group n = 24	ATD group n = 21	t test
Age (year)	75.8 ± 4.9	78.6 ± 7.2	n. s
MMSE (score)	28.9 ± 1.4	19.8 ± 4.4	**
CDR (score)/The number of people	0/24	0.5/19, 1/ 2	–
ATD = Alzheimer's type of dementia NC = Normal control MMSE = Mini-Mental State Examination CDR = Clinical Dementia Rating	n. s = not significant		**p < 0.01

disorders) [11], (b) had a Mini-Mental State Examination (MMSE) score of 15 points or above, and (c) had a Clinical Dementia Rating (CDR) of 0.5 or 1. Subjects whose symptoms of ATD could be considered to be at the mild stage according to these selection criteria (hereinafter referred to as subjects with mild ATD) were included in the study.

Subjects with other disorders of the central nervous system were excluded from the study. As a result, the ATD group was composed of 21 subjects (8 patients living in facilities and 13 at home) including 7 residents of geriatric health care facilities, 10 outpatients, and 4 group home residents. In terms of gender, the group included 2 males and 19 females, aged 78.6 ± 7.2 years (range: 65–91 years). The ATD group had an MMSE score of 19.8 ± 4.4 (range: 15–27), and the

CDR was 0.5 for 19 subjects and 1 for 2 subjects (Table 1).

2) Normal control group

The normal control (NC) group was defined as those who had an MMSE score of 25 or higher, who had no previous history of diseases of the central nervous system, and who were capable of performing self care independently. From a total of 24 people (6 males and 18 females), 13 were participants in preventive care classes, and 11 were volunteers in nursing and healthcare facility for the elderly. All the subjects lived in their own homes. The NC group had an average age of 75.8 ± 4.9 years (range: 67–93 years) and an MMSE score of 28.9 ± 1.4 (range: 27–30) (Table 1). Subjects who corresponded to the category of MCI based on the criteria for the diagnosis of MCI according to J-COSMIC (2006), were excluded [12].

Table 2. Contents of tasks for the At-the-Desk IADL Test and rules

Task No.1 ; Making a telephone call Please look for the phone number of Ichiro Shimizu from an address book. And please call.
Task No.2 ; Wipe the table while holding the receiver
Task No.3 ; Folding clothes Please fold a jacket and underwear and a towel on the table. Separate them, and please place each item into the clothing drawers.
Task No.4 ; Disposing of trash by sorting them by type. Please put the various types of trash into their respective trash boxes.
Task No.5 ; Boiling hot water in a pot Water is in the electric pot. Please plug the cord into the outlet, and bring the water to a boil.
Task No.6 ; Unplug the cord from the outlet when the hot water boils
Task No.7 ; Shelving books on shelves by arranging them by type
Task No.8 ; At the end, hold up the end card when you believe that you have completed the task.
Rules <ul style="list-style-type: none"> • Please perform each task (Task No.1 to No.8). • The time limit is five minutes . It takes four minutes for the water to boil. • Please think about the order or sequence for whichever task you begin with. • You may refer to the instruction sheet and rules at any time.
Task No.9 ; Counting money Counting money task was performed after the above one through eight were completed. Please take out 426 yen from the wallet, and count it.

A comparison (t test) between the ATD group and the NC group showed no significant difference in ages, but there was a significant difference in the MMSE scores (Table 1).

This study has received the approval (No. 150) of the Medical Ethics Committee of Kanazawa University, and written consent was obtained from the participants after the contents of the study were explained in a written document. For subjects with ATD, written consent was obtained after the contents of the study were explained to their families through written documents.

2. Methods used in the At-the-Desk IADL Test

1) Selection of tasks for the At-the-Desk IADL Test, and rules and guidelines for how to conduct them

The At-the-Desk IADL Test was based on the Validity of a Clearing up Test, which we performed in previous studies [10], but it included only the nine tasks, as listed in Table 2, which were practicable at the desk. The nine tasks and the rules for carrying them out in the evaluation of executive functions are described in Table 2. We

ensured that the ability to conceive plans could also be evaluated (see rules, Table 3). The money-counting task (Task No.9) was performed after the rest of the test because it was considered difficult for the subjects to perform while following the rules of the At-the-Desk IADL test.

2) Equipment and space used in the At-the-Desk IADL Test

During the At-the-Desk IADL Test, the following items were put on a 1.2m×0.75m table, in the same place each time: a bookshelf, a clothes case, a dishtowel, trash boxes, and a table clock (Figure 1). The following were randomly placed on the table every time: books (B5-size magazines of two types, four of each), three kinds of trash (five empty cans as trash made of metal, five plastic bags as trash made of plastic, and five crumpled advertisement papers as combustible trash), two towels, two short-sleeved jackets, and two running shirts.

3) Procedure for the At-the-Desk IADL Test

The procedure for the At-the-Desk IADL Test was as follows: The examiner read aloud and showed the subjects the tasks and rules pertaining

Table 3. Scoring method in the At-the-Desk IADL Test”

1) For the At-the-Desk IADL Test, for all tasks ranging from Task No.1 to No. 9, a score of “4” was given when the subject’s behavior was found to be appropriate; and conversely, 1 point was deducted from the score for each inappropriate behavior observed.
2) Scoring of appropriate and inappropriate behaviors; following the rule of At-the-Desk IADL test, 1 point was added to the score each time an appropriate behavior was observed, and 1 point was deducted from the score each time an inappropriate behavior was observed.
3) Scoring of the sequence of performance of the tasks; The most efficient sequence pattern for performing the tasks was envisioned beforehand (Table 6). A maximum score of 8 was given when the tasks were performed in this order pattern, and 1 point was deducted from the score for each difference in the sequence of performance; therefore, the score was categorized into 9 levels ranging from 8 to 0.
4) Scoring the amount of time needed for the entire At-the-Desk IADL Test, “time 1,” and “time 2.”; Based on the median, the minimum and maximum of the duration of the test in the NC and ATD group, a maximum score of 4 was given for values ranging from 75% to the maximum, a score of 3 was given for values ranging from the median to 75% less than rank point, a score of 2 was given for values ranging from 25% up to the median, a score of 1 was given for values ranging from the minimum to 25% less than rank point. Thus, the scores were evaluated as 4 levels ranging from 4 to 1. From the scoring described above, the maximum total score for the At-the-Desk IADL Test” was 59. <ul style="list-style-type: none"> • The score and the time of “time 1” [4=0 to 1.0, 3=1.1 to 2.0, 2=2.1 to 3.0, 1=3.1 to 36.0 (second)] • The score and the time of “time 2” [4=0 to 1.0, 3=1.1 to 2.0, 2=2.1 to 6.0, 1=6.1 to 240.0 (second)] • The score and the time of At-the-Desk IADL Test enforcement time [4=111.0 to 185.0, 3=185.1 to 248.0, 2=248.1 to 361.0, 1=361.1 to 600.0 (second)]
The score of the test in total is 59 points [from 1) to 4) of Scoring method in the test].

“time 1” = The following were measured and recorded using a stopwatch: the time interval from the beginning of the test to the time when the subject gets started with the first task.

“time 2” = The time interval from the completion of the first task to the time when the subject gets started with the next task.

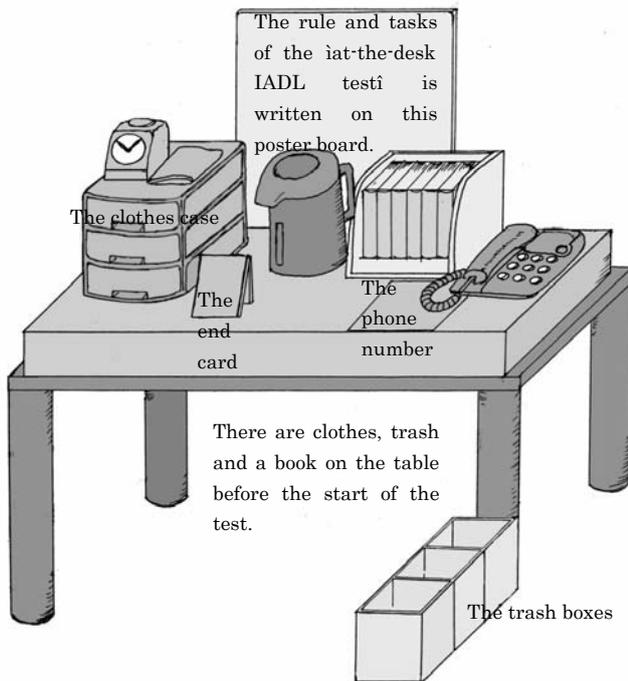


Figure 1. An illustration of equipment placement for the At-the-Desk IADL Test"

to the At-the-Desk IADL Test as listed in Table 2 (hereinafter referred to as tasks and rules), and asked questions to confirm their understanding. The At-the-Desk IADL Test began when the examiner said, "Please start," and was ended when the subject held up a card marking the completion of task No.8.

The subjects' behavior during the At-the-Desk IADL Test was recorded using a video camera (VTR).

4) Notation and scoring methods used in the At-the-Desk IADL Test

⟨1⟩ Three occupational therapists (with 17, 14, and 10 years of experience) watched the VTR images, and when the subjects behaved differently from what was expected based on the tasks listed in Table 2, this was noted as an inappropriate behavior. When the behavior was in accordance with the tasks, this was noted as an appropriate behavior.

⟨2⟩ The notations were made by quoting the rules of the At-the-Desk IADL Test regarding appropriate behaviors and inappropriate behaviors.

⟨3⟩ The sequence of performance of each task was noted.

⟨4⟩ In order to measure the planning time

required by the subjects to perform the At-the-Desk IADL Test, the following intervals were measured and recorded using a stopwatch: the time interval from the beginning of the test to the time when the subject started the first task (hereinafter referred to as time 1), the time interval from the completion of the first task to the time when the subject started the next task (hereinafter referred to as time 2), and the time it took for the subject to perform all tasks from Task No.1 through Task No.8.

5) IADL Evaluation Scale and neuropsychological tests conducted to confirm the validity of the At-the-Desk IADL Test, and their influencing factors

Evaluations using the IADL Scale and the FAI were performed to determine concomitant validity with the At-the-Desk IADL Test. Because the scoring criteria were different in men (maximum score =5) and women (maximum score =8), the scoring for men was converted to change the maximum score to 8. Next, in order to examine the influence of the higher brain functions and the symptoms of depression on the At-the-Desk IADL Test, we performed the Digit span backward test (a subtask of the neuropsychological test Wechsler Memory Scale—Revised (WMS-R) [13]) to evaluate attention function, the Promise Test (a subtask of the Rivermead Behavioral Memory Test (RBMT) [14]) to evaluate prospective memory, BADS to evaluate executive functions, and cube-copying as a composing task. In the cube-copying task, a score of 2 was given when the cube was correct, a score of 1 when there was a mistake, and a score of 0 when the subject was unable to reproduce the cube. Regarding BADS, both the Zoo Map Test and the Modified Six Elements Test were excluded for several reasons: they take more time than other subtasks, most scores were either 0 or 1, and a floor effect was observed in patients already at the stage of mild ATD [10]. Only four subtests were performed: the Rule Shift Cards Test, the Action Program Test, the Key Search Test, and the Temporal Judgment Test, and the score data was calculated as follows: 4 points × 4 tests = 16 points. The Geriatric Depression Screening Scale

—15 (GDS-15) was used for the evaluation of depression.

3. Scoring method in the At-the-Desk IADL Test

Table 3 shows scoring method in the At-the-Desk IADL Test.

- 1) The scoring of appropriate and inappropriate behaviors based on the Task No.1 to No.9.
- 2) The scoring of appropriate and inappropriate behaviors based on the rules of At-the-Desk IADL Test.
- 3) Scoring of the sequence of performance of the tasks.
- 4) Scoring the amount of time needed for the entire At-the-Desk IADL Test, time 1, and time 2. The score of the test is 59 points in total from 1) to 4) of the scoring method.

4. Method of analysis in the At-the-Desk IADL Test

The At-the-Desk IADL Test was analyzed by examining its reliability, its validity, and the factors affecting the test.

1) Analysis of the reliability of the At-the-Desk IADL Test

The reliability of the At-the-Desk IADL Test was studied by examining the intra-rater reliability and the test-retest reliability. In total, the reliability study was conducted on 30 of the 45 participants after excluding 9 subjects from the ATD group and 6 subjects from the NC group who were not willing to cooperate in the reliability study. The intra-rater reliability was analyzed as follows. First, a second occupational therapist marked the list of the appropriate and inappropriate behaviors in Table while watching the video recorded at the scene of the At-the-Desk IADL Test; at the same time, scores were given by measuring the duration it took to perform the task, and the correlation coefficient between the resulting scores and those reached by the first author (Spearman's rank correlation coefficient) was calculated ($p < 0.05$). The appropriate and inappropriate behaviors in Table increased entry columns of other inappropriate behaviors in Table 5 (Table 5 shows the results pertaining to the determination of construct validity). The test-retest reliability was analyzed

as follows. A second At-the-Desk IADL Test was performed 30 minutes after the first test, and the correlation coefficient between the scores obtained during the first and the second tests (Spearman's rank correlation coefficient) was calculated. The level of significance was set to 5% for both the intra-rater reliability and the test-retest reliability.

2) Analysis of the validity of the At-the-Desk IADL Test

〈1〉 Examination of the construct validity of the At-the-Desk IADL Test

Construct validity was assessed by comparing the At-the-Desk IADL Test scores of the ATD group with those of the NC group, using t test. Because the scores of the sub-items were not normally distributed, they were compared using the Mann-Whitney U Test ($p < 0.05$). Moreover, in order to examine the construct validity of the scoring contents for the At-the-Desk IADL Test:

(1) Significant differences between the two groups were calculated using the chi-square (χ^2) test ($p < 0.05$) on the number of occurrences of "appropriate behaviors" and "inappropriate behaviors" exhibited in the At-the-Desk IADL Test.

(2) We calculated the percentage ratio of participants who performed tasks 1 to 8 in the same sequence pattern as that which was assumed to be most efficient (number of relevant subjects / number of control subjects $\times 100$).

〈2〉 Study of concomitant validity in the At-the-Desk IADL Test

Concomitant validity was determined using the correlation coefficient (Spearman's rank correlation coefficient) between the At-the-Desk IADL Test scores and the IADL Scale and the FAI ($p < 0.05$).

〈3〉 Determination of the factors influencing the At-the-Desk IADL Test

To examine the influence of higher brain dysfunction and other factors on the At-the-Desk IADL Test, stepwise multiple linear regression analyses were performed using age, gender, neuropsychological test scores, and GDS-15 scores as independent variables, and the total score from the At-the-Desk IADL Test as a dependent variable. Stepwise forward and backward selection method with $P_{in} = 0.25$ $P_{out} = 0.25$.

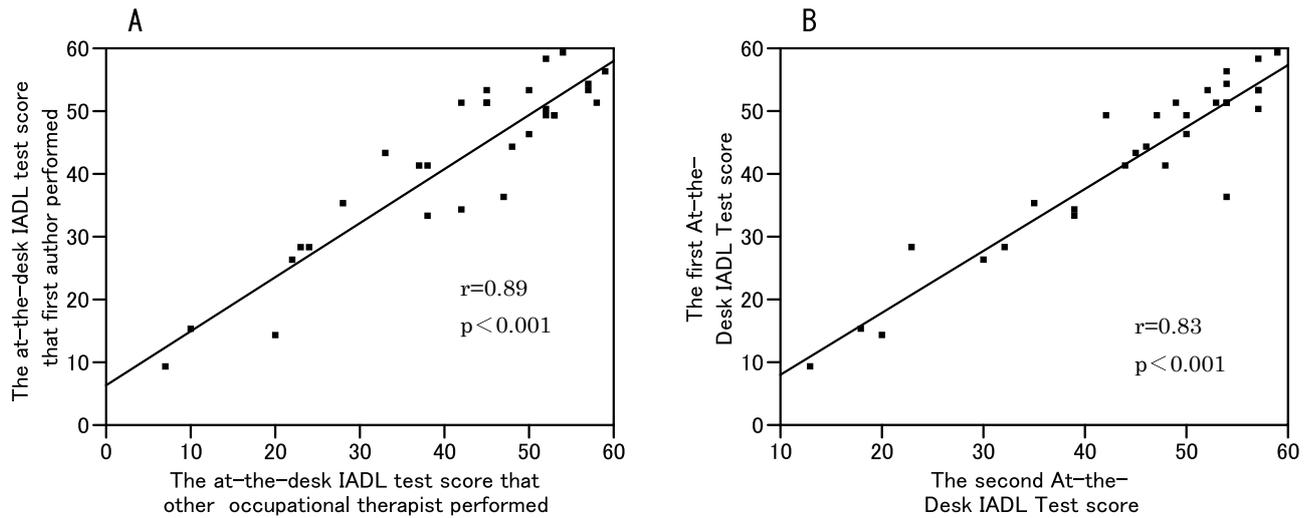


Figure 2. Results pertaining to intra-rater reliability(A) and test-retest reliability(B)

Results

1) Results pertaining to intra-rater reliability and test-retest reliability

Figure 2 shows the results pertaining to intra-rater reliability and test-retest reliability. Regarding intra-rater reliability, a correlation was found with $r=0.89$ ($p<0.001$). Regarding the test-retest reliability, a correlation was also found with $r=0.87$ ($p<0.001$).

2) Results pertaining to the determination of construct validity

Table 4 shows the results of the At-the-Desk IADL Test for the two groups. The At-the-Desk IADL Test scores were 49.0 ± 6.5 in the NC group and 22.3 ± 9.0 in the ATD group, and a significant difference was found between the two groups ($p<0.001$). The results also showed that the At-the-Desk IADL Test sub-item scores were significantly

Table 4. Score result of the At-the-Desk IADL Test

	NC group	ATD group	Mann-Whitney U test
Task No.1 ; Making a telephone call	3.9 ± 0.5	1.4 ± 1.7	***
Task No.2 ; Wipe the table while holding the receiver	2.6 ± 1.5	0.5 ± 1.0	***
Task No.3 ; Folding clothes	3.8 ± 0.6	2.4 ± 1.5	***
Task No.4 ; Disposing of trash by sorting them by type	4.0 ± 0.0	2.5 ± 1.2	***
Task No.5 ; Boiling hot water in a pot	3.9 ± 0.4	1.2 ± 1.8	***
Task No.6 ; Unplug the cord from the outlet when the hot water boils	2.0 ± 2.0	0.3 ± 1.0	**
Task No.7 ; Put books on shelves by arranging them by type shelving books	4.0 ± 0.0	3.1 ± 1.0	***
Task No.8 ; At the end, hold up the end card when you believe that you have completed the task	3.1 ± 1.7	1.3 ± 1.6	**
Task No.9 ; Counting money	3.9 ± 0.4	3.1 ± 1.2	**
The score of appropriate behaviors throughout the rules of At-the-Desk IADL Test.	2.9 ± 0.3	$1.9 \pm .9$	***
The score of inappropriate behaviors throughout the rules of At-the-Desk IADL Test".	0.0 ± 0.0	-0.7 ± 0.5	***
The score of the sequence of performance of the tasks	4.9 ± 2.0	1.4 ± 1.0	***
The score of "time 1"	3.3 ± 0.9	1.6 ± 0.8	***
The score of "time 2"	2.9 ± 1.0	1.9 ± 0.9	***
The score of At-the-Desk IADL Test enforcement time	3.5 ± 0.7	2.0 ± 1.3	***
			<i>t</i> test
Total score of At-the-Desk IADL Test"	49.0 ± 6.5	22.3 ± 9.0	***

** $p<0.01$ *** $p<0.001$

Table 5. The differences between the occurrences of appropriate and inappropriate behaviors observed in the At-the-Desk IADL Test

Task No.	The appropriate and inappropriate behaviors	ATD group n=21	NC group n=24	χ^2 test
Task No.1 inappropriate behaviors	The subjects pushed the button key of the telephone with a dish towel.	1	0	n.s
	the subjects held the receiver in the wrong way.	1	0	n.s
	The movement of subjects stopped on the way.	1	0	n.s
	The subjects pushed the keys without lifting the receiver first.	2	0	n.s
	The subjects telephoned someone other than Ichiro Shimizu .	1	0	n.s
Task No.1 appropriate behaviors	The subjects put the receiver on the table.	1	0	n.s
Task No.2 inappropriate behaviors	The study subject went according to a task rule (table 2).	5	23	***
	The movement of subjects stopped on the way.	1	0	n.s
	The subjects revised movement.	0	2	n.s
	The subjects performed the wiping task while not holding the receiver.	3	3	n.s
	The subjects wiped the table after the test ends.	1	0	n.s
	The subjects wiped the table with a dish towel before putting a book or clothes in order.	1	0	n.s
	The subjects did not wipe the entire surface of the table	2	1	n.s
Task No.2 appropriate behaviors	The subjects did not have the receiver while wiping the table.	5	7	n.s
	The subjects wipe a table with a something other than the dish towel.	1	1	n.s
	The study subject went according to a task rule (Table 2).	1	11	***
Task No.3 inappropriate behaviors	The subjects did not receive several clothes.	1	0	n.s
	the subjects fold clothes but did not put them into the drawers.	1	0	n.s
	The subjects made an error in the classification of clothes.	6	1	n.s
	The subjects put clothes and a dish towel away to the clothes case.	3	1	n.s
	The subjects folded clothes on top of other folded clothes.	1	0	n.s
Task No.3 appropriate behaviors	The study subject went according to a task rule (Table 2)	8	22	***
Task No.4 inappropriate behaviors	The movement of subjects stopped on the way.	1	0	n.s
	The subjects attempted to fold the trash in the plasticvinyl bag.	2	0	n.s
	The subjects made an error in classification of the trash.	8	1	*
	The subjects forgot to throw away some of the trash.	4	0	n.s
	The subjects put trash away in the place except the trash box.	1	0	n.s
	The subjects threw non-trash items into the trash box.	5	0	*
	The subjects forgot the location of the trash box.	4	0	n.s
	The subjects lost trash on the floor and did not notice it.	1	0	n.s
Task No.4 appropriate behaviors	The study subject went according to a task rule (Table 2).	7	24	***
Task No.5 inappropriate behaviors	The subject was not able to pull out the cord from the outlet.	1	0	n.s
Task No.5 appropriate behaviors	The study subject went according to a problem rule (Table 2).	6	23	***
Task No.6 inappropriate behaviors	The study subject touched the outlet, but did not pull the cord.	0	1	n.s
	The subjects heard boiling sound. However, they did nothing.	11	0	**
	The subjects pulled the plug before boiling was achieved.	1	0	n.s
Task No.6 appropriate behaviors	The study subject went according to a task rule (Table 2).	1	11	***
Task No.7 inappropriate behaviors	The subject did not put place the books on the bookshelf.	1	0	n.s
	The subject did not understand the task.	1	0	n.s
	The subject incorrectly classified the books.	6	0	*
	The subject laid a book flat on the shelf rather than in the proper standing position			
Task No.7 appropriate behaviors	The subject attempts to do something other than putting a book on the bookshelf	3	0	n.s
	The study subject went according to a task rule (Table 2).	11	24	***
Task No.8 inappropriate behaviors	The subjects held the end card in their hand without displaying the end side.	1	0	n.s
	The subjects leaned the card against the clothes case.	2	0	n.s
	The subjects had to ask "what does this card do?"	2	0	n.s
Task No.8 appropriate behaviors	The study subject went according to a task rule (Table 2).	4	18	***
Task No.9 inappropriate behaviors	The subjects were not able to look for all the money in the wallet.	7	1	*
	The subjects made a mistake in counting money.	3	0	n.s
	The subjects were not able to say the amount of money.	4	0	n.s
	The subjects misspoke and then corrected themselves.	1	0	n.s
	The subject said "I cannot perform it" and did not perform it.	1	0	n.s
Task No.9 appropriate behaviors	The study subject went according to a task rule (Table 2).	12	24	***
The inappropriate behaviors about rule of the "at-the-desk IADL test"	While the researcher was directing the subjects to look at the rules written on the poster board, the subjects were not paying attention.	3	0	n.s
	The researcher observed unknown behavior on the part of the subjects.	12	0	***
The appropriate behaviors about rule of the "at-the-desk IADL test"	There was a question about enforcement order from the subjects.	13	24	***
	The subjects observed a task rule after a test started.	10	23	***
	There were some kind of questions about task contents from the subjects.	15	20	n.s

ATD=Alzheimer's type of dementia NC=Normal control

n.s=not significant *p<0.05 **p<0.01 ***p<0.001

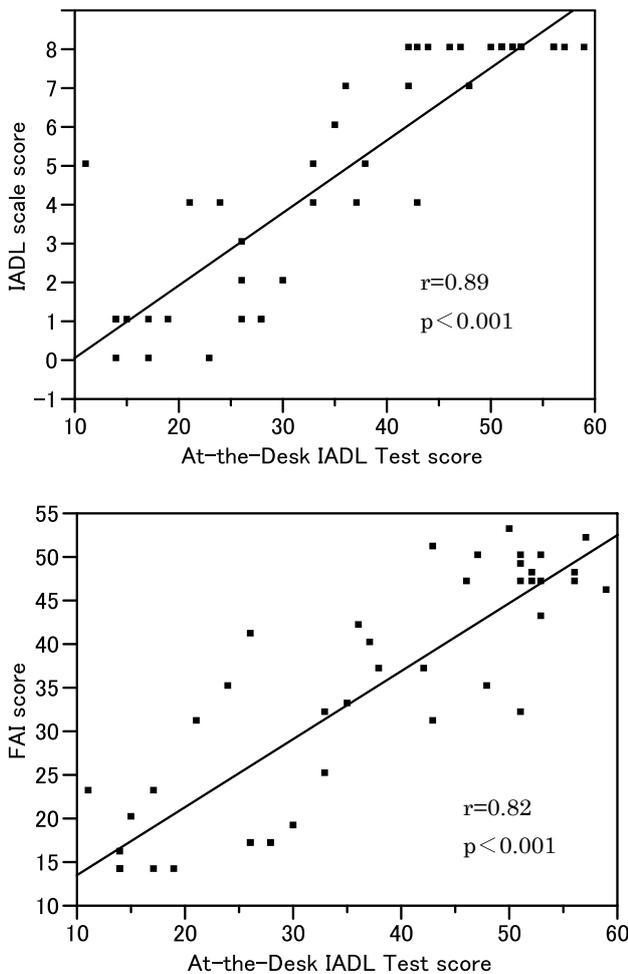


Figure 3. Correlative results to be able to put between The At-the-Desk IADL Test" and each IADL scales
 IADL Scale=Instrumental Activities of Daily Living Scale
 FAI=Fenchay Activities Index

lower in the ATD group ($p<0.01$). Table 5 shows the differences between the occurrences of appropriate and inappropriate behaviors observed in the At-the-Desk IADL Test.

In the ATD group, there were significantly fewer appropriate behaviors in all the tasks (no.1 – 9). Many of the different sorts of inappropriate behaviors listed for each task were observed in a small number of people.

There were differences between the NC group and the ATD group in terms of sequence pattern when performing the tasks included in the At-the-Desk IADL Test (Table 6). In total, 21 of 24 subjects (82.0%) performed the tasks using sequence patterns, which were assumed to be efficient, and patterns derived from those. The majority of the NC subjects performed the tasks using either sequence patterns, which were assumed to be efficient, or patterns derived from those. On the other hand, only 1 of 21 participants (4.8%) in the ATD group performed the tasks using derived patterns.

3) Results of the determination of concomitant validity in the At-the-Desk IADL Test

A strong correlation was found between the At-the-Desk IADL Test scores and the IADL Scale and the FAI used for the determination of

Table 6. Difference of the sequence of performance in the At-the-Desk IADL Test tasks of NC group and ATD group

	NC group (n=24) number of people / ratio(%)	ATD group (n=21) number of people / ratio(%)
A	4 / 16.0	0 / 0
Derivation of A , A1	7 / 28.0	0 / 0
Derivation of A , A2	5 / 20.0	0 / 0
Derivation of A , A3	2 / 8.0	0 / 0
Derivation of A , A1+A2	3 / 12.0	1 / 4.8
Total of A + Derivation of A	21 / 82.0	1 / 4.8
B	3 / 18.0	20 / 95.2

A = The most efficient sequence pattern in performing the tasks was envisioned beforehand [Boil hot water in a pot , Fold clothes, and put books in shelves by arranging them by type, and throw out the trash by sorting them by type (there is no particular order for these 3 tasks), Making a telephone call, Wipe the table while holding the receiver , Unplug the outlet when the hot water boils, At the end, hold up a card indicating the completion of the task].

Derivation of A , A1 = It is a sequence of performance of A pattern, however, either of the tasks is non-enforcement.

Derivation of A , A2 = It is a sequence of performance of A pattern, however, the pattern that a beginning of the sequence of performance does not have "Boil hot water in a pot".

Derivation of A , A3 = It is a sequence of performance of A pattern. However, the pattern that contains another task between "Making a telephone call" and "Wipe the table while holding the receiver is stated".

Derivation of A , A1+A2 = An sequence of performance order pattern is a compound pattern of A1 and A2.

B = Other than a derivation sequence of performance of A and A patterns.

concomitant validity, with $r = 0.89$, and $r = 0.82$ ($p < 0.001$) respectively (Figure 3). And the IADL Scale score was calculated as ceilings, but the FAI score was not calculated as it.

4) Results of the study of the factors influencing the At-the-Desk IADL Test

Using the stepwise method, a multiple linear regression analysis of the At-the-Desk IADL Test was performed using age and gender as dependent variables, and GDS-15 and the data from each of the neuropsychological tests as independent variables. As a result, the composing task, the RBMT Promise Test, the WMS-R Backward Digit Span Test, and BADS were adopted. Gender and GDS-15 were not adopted.

The results showed the contribution rate of the At-the-Desk IADL Test scores was as high as the contribution rate for these four factors ($R^2 = 0.84$, Table 7). The linear multiple regression model was expressed in $Y = 2.64 \chi_1 + 3.37 \chi_2 + 2.79 \chi_3 + 1.53 \chi_4 + 6.89$ ($\chi_1 =$ composing task, $\chi_2 =$ RBMT Promise Test, $\chi_3 =$ WMS-R Backward Digit Span Test, $\chi_4 =$ BADS). The results of neuropsychology test adopt in multiple linear regression analysis shows Table 8.

Table 7. Results of multiple linear regression analysis on the factors influencing the At-the-Desk IADL Test

	Standard β	t	p
Composing task	0.15	2.05	*
RBMT promise test	0.23	2.46	*
WMS-R digit span backwards test	0.41	5.04	***
BADS	0.35	4.48	***
Coefficient of determination (R^2) = 0.84			
Adjusted coefficient of determination ($R^{2'}$) = 0.83			
Root mean-square error (RMSE) = 6.00			
Composing task = Cube-copying			*** $p < 0.001$
RBMT = The Rivermead Behavioral Memory Test			* $p < 0.05$
WMS-R = Wechsler Memory Scale-Revised			
BADS = The Behavioural Assessment of the Dysexecutive Syndrome			

Table 8. Results of neuropsychology test adopt in multiple linear regression analysis

neuropsychology test (score)	NC group	ATD group
Composing task	1.9 \pm 0.2	1.2 \pm 0.8
RBMT promise test	1.3 \pm 0.8	0.04 \pm 0.2
WMS-R digit span backwards test	6.7 \pm 2.0	4.3 \pm 1.5
BADS	10.9 \pm 2.3	6.2 \pm 2.7

Discussion

The purpose of this study was to develop and investigate the reliability and validity of a test capable of assessing executive function abilities in IADL at a desk. The reliability of the At-the-Desk IADL Test showed a high correlation with both the intra-rater reliability and the test-retest reliability ($r = 0.83$, $r = 0.87$); therefore, the test was considered reliable. The intra-rater reliability was high, presumably because of the scores obtained by marking the appropriate and inappropriate behaviors in the At-the-Desk IADL Test, listed in the appropriate and inappropriate behaviors in Table (The Table increased entry columns of other inappropriate behaviors in Table 5).

Because significant score differences were found between the ATD group and the NC group (Table 4), the At-the-Desk IADL Test is considered to have construct validity. A significant difference in the occurrences of appropriate behaviors was found in all the tasks (Task No.1–9) for ATD patients.

In the “Validity Cearing up Test” that we performed in a previous study, we selected organizing tasks and clean-up tasks, which, according to reports published by Douglas et al. [3] and Hanaki et al. [4], are impaired in ATD patients. When one more prospective memory task was added, a significant difference of scores was found between the healthy group and the ATD group [10]. In the performance of prospective memory tasks, including organizing, clean up, and boiling water in a pot (Task No.5), significantly fewer subjects performed the tasks using appropriate behaviors in the ATD group. This time, the studied ATD group consisted of subjects with mild ATD. All the selected tasks were difficult for subjects with mild ATD to perform; therefore, those tasks were suitable to distinguish healthy subjects from those with mild ATD. The At-the-Desk IADL Test is based on a principle according to which points are deducted from the score when inappropriate behaviors are observed.

Therefore, the scores from this test might also reflect the differences between each individual ATD patient’s various symptoms in the form of

inappropriate behaviors.

Next, we would like to discuss the differences between the healthy group and the ATD group in terms of sequence patterns while performing the tasks of the At-the-Desk IADL Test (Table 6). The healthy group showed a commonality of sequence patterns when they performed the tasks. Specifically, they put the pot’s plug into an outlet; cleaned up the clothes, books, and trash on the table; and then wiped the table. This is because using the pot to boil water would take time, so they judged that it was appropriate to perform that task first. In the next step, subjects intended to clean up everything on top of the table by putting away the clothes and the books and throwing away the trash before the task of wiping the table. Thus, the subjects who performed each task in the same sequence as the healthy group had presumably made a prior judgment about how to conduct the task efficiently without wasting time. In contrast, in the ATD group, only one subject performed the tasks in the aforementioned sequence pattern; therefore, it could be determined that subjects acted without making prior judgments on the efficient sequence pattern to conduct the task. It can be inferred that the subjects’ executive functions were markedly weakened, and their ability to set up a plan was reduced [15].

The strong correlation between the respective scores in the IADL Scale and FAI (Figure 3) found during the At-the-Desk IADL Test might indicate a high concurrent validity. Sharon et al. [16] and Susanne et al. [17] stated that they had found a correlation with the IADL Scale by using AMPS, and that the correlation was moderate. Both the At-the-Desk IADL Test and AMPS are used for behavioral assessment. Nevertheless, the fact that the At-the-Desk IADL Test showed a stronger correlation with the results of the evaluation of IADL was probably because it more accurately reflects the symptoms in ATD patients than AMPS does.

The multiple regression analysis for the determination of factors influencing the results of the At-the-Desk IADL Test showed that the following four factors had a high contribution rate:

the “digit span backwards test” in the WMS-R test, the composing task, the “promise test” in the RBMT test, and BADS (Table 7). This suggests that the At-the-Desk IADL Test is strongly influenced by these four factors. Therefore, it can be said that the At-the-Desk IADL Test strongly reflects concentration, delayed recall memory performance, composing abilities, prospective memory, and executive functions. According to Honma [2], “the three initial symptoms in people with ATD are memory impairment, attention distribution disorder, and executive dysfunction.” According to Maejima [18], “people with ATD have a prospective memory disorder,” and according to Takeda [19], “the incapacity to perform the cube-copying task is a factor for the onset of dementia.” In consideration of these findings and combined with the fact that the ATD group in our study had a mild stage of the disease, it can be speculated that the At-the-Desk IADL Test can easily detect the effects of the initial symptoms in people with ATD. Hanaki [4] and Lowton et al. [20] previously pointed out that there were sex differences in the degree of performance of IADL, and it has also been indicated that about 30% of people with ATD in Japan presented with symptoms of depression [21]. However, in the results of the analysis conducted in this study, neither gender nor the GDS-15 depression assessment scale were adopted, and therefore the At-the-Desk IADL Test can be considered to be useful, and not greatly influenced by depressive symptoms. There is a possibility that gender is hard to influence the At-the-Desk IADL Test. However, the investigation will be necessary in future because there are few people of the males ($n=8$). Therefore, it can be said that the At-the-Desk IADL Test evaluates IADL performance and reflects the symptoms in subjects with mild ATD, and may be more useful than AMPS. The At-the-Desk IADL Test can capture the difference between the normal persons and ATD persons using qualitative evaluation (appropriate and inappropriate behaviors, sequence of performance of the tasks). This is a characteristic that the IADL Scale does not have. ATD patients who actually need IADL evaluation include those who

receive nursing and preventive care while living at home, and those subjects who come for outpatient consultation for memory loss. In that regard, it can be said that the At-the-Desk IADL Test is useful since it can be performed at the desk and in a short time. The At-the-Desk IADL Test is particularly helpful from the perspective of assessments in nursing and preventive care programs because it does not require any special tools.

Future Work

The At-the-Desk IADL Test seems useful, but we would like to conduct further study on its clinical usefulness, specifically, whether the test can detect the changes occurring in subjects when used in a follow-up study, and whether it corresponds to the actual changes in IADL. In the future, we also plan to examine whether the appropriate and inappropriate behaviors observed in the At-the-Desk IADL Test can also be observed in the actual setting of an IADL test, and whether it is a factor in determining the need for assistance.

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アルツハイマー型認知症者を対象にした机上で実施可能な IADL検査の開発と妥当性の検討

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要 旨

アルツハイマー型認知症 (ATD) 用の手段的日常生活活動 (IADL) スケールは、評価者が直接対象者に対して簡便に評価可能なものはない。そこで、我々は机上で実施可能な IADL 評価方法 (机上 IADL 検査) の開発を試みた。対象は、健常群 24 名 (MMSE 28.9 ± 1.4) と ATD 群 21 名 (MMSE 19.8 ± 4.4) とした。机上 IADL 検査の課題は、電気ポットでお湯を沸かす、お湯が沸いたらコンセントを抜く、電話をかける、などの IADL の課題を 9 つ設定した。また、検査規則として、課題実施順番は自分で考えること、などを伝えた。得点化は、各課題の適切・不適切行動と検査実施時間、実施順序を対象に行い、合計 59 点満点とした。さらに、机上 IADL 検査に影響する因子と妥当性を検討するために、各神経心理学的検査を実施し、IADL 評価スケールとして、IADL Scale と Fenchay Activities Index (FAI) を実施した。その結果、2 群の得点比較では有意差が認められた。また、机上 IADL 検査は IADL Scale、FAI とともに強い相関を認め ($r=0.89$, $r=0.82$, $p<0.001$)、重回帰分析では、机上 IADL 検査得点に対し「遂行機能症候群の行動評価」、「改訂ウェクスラー記憶検査・逆唱課題」、「リバミード行動記憶検査・約束課題」、「構成課題」により、高い寄与率 ($R^2=0.84$) が示された。机上 IADL 検査は、IADL 評価スケールとの相関が高いこと、重回帰分析の結果から、ATD の認知機能をよく反映した併存妥当性の高い検査と考えられた。