**ORIGINAL ARTICLE**

**Risk Factors for Impaired Instrumental Activities of Daily Living in Alzheimer’s Disease**

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**Abstract:** Objective: Despite the considerable importance of maintaining support for instrumental activities of daily living (IADLs) for patients with dementia living at home, there have been no formal investigations of what factors influence IADLs.

Method: We administered various neuropsychological tests, the Timed Up and Go [TUG] test, and the Geriatric Depression Screening Scale-15 to 54 individuals in Japan who had visited a day care center or a preventative care class and who had either 23 mild Alzheimer’s disease (mild AD) or 31 no dementia. IADLs were measured using the Self-Report Frenchay Activities Index.

Results: The factors related to the domestic chores subscale of the Frenchay Activities Index were gender, backward digit recall performance (Wechsler Memory Scale-Revised [WMS-R]), and TUG test performance ($R^2 = 0.53$). Factors related to the leisure/work subscale were backward digit recall and logical memory II performance on the WMS-R, scores on the Behavioral Assessment of the Dysexecutive Syndrome, and TUG test performance ($R^2 = 0.66$). Finally, factors related to the outdoor subscale were backward digit recall, logical memory II, and the TUG test performance ($R^2 = 0.62$).

Conclusions: The factors affecting IADLs among elderly individuals with mild AD or no dementia vary depending on the type of IADL. Notably, TUG test performance has a direct influence on all IADL types, and might relate to cognitive function. When providing preventative care or IADL support, it may be beneficial to evaluate and intervene with a focus on the cognitive and physical functions highlighted in this study.

Keywords: Alzheimer’s disease, cognitive function, environmental factors, neuropsychological tests

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**Introduction**

There were an estimated 5.2 million people with Alzheimer’s disease (AD) in the United States in 2013 [1]; therefore, policies to combat AD constitute an urgent international priority. The Japanese population has aged at an accelerated rate in recent years. In addition, in 2012, the Ministry of Health, Labour and Welfare reported that the population of individuals with dementia had reached 3 million [2]. AD and cerebrovascular disorders with comorbid AD account for approximately 70–80% of dementia cases [2].

In response to the rapid increase in dementia cases, the Ministry of Health, Labour and Welfare established the 5-year “Orange Plan” to promote policy measures against dementia. One of the concrete features of the plan is the improvement of at-home, early-term, intensive support for cognitive function for individuals with early-stage dementia. More specifically, it aims to create additional opportunities for provision of support for activities of daily living (ADLs) for people with very mild or mild AD. Although it is possible for these individuals to perform certain home-based ADLs, such as feeding themselves and using the toilet, they are known to experience difficulty performing “instrumental” ADLs (IADLs), such as shopping and household budgeting/money management [3]. Indeed, according to Ueda, Takayama, Koyama, and Osaka’s independent IADL survey [4], Laurent et al.’s 8-item IADL scale [5], and
the Alzheimer’s Disease Cooperative Study IADL scale developed by Galasko et al. [6], individuals with mild AD showed impaired IADL performance. All of these reports mentioned similar impairment in performance of IADLs, including meal preparation (e.g., cooking), traveling to a particular location for the first time, keeping one’s home and oneself neat and tidy, and managing finances, in patients with mild AD. Previous research showed that individuals with mild AD experienced disability in specific types of IADL; therefore, it is logical to assume that different types of IADL are affected by different factors.

According to the diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision [7] and a report created by the National Institute of Neurological and Communicative Disorders and Stroke, in collaboration with the Alzheimer’s Disease and Related Disorders Association [8], cognitive disorders associated with memory loss have been implicated in IADL impairment in mild AD. Indeed, amnesia-like memory impairment is a confirmed characteristic of individuals with AD and one of the core clinical criteria for diagnosis of the disorder [9]; furthermore, memory impairment is listed as a prominent symptom that begins during the early stages of probable dementia of the Alzheimer’s type, while anterograde amnesia is particularly apparent in early-phase AD [10]. According to Perry and Hodges [11], impairment of attention and visuospatial cognition, in addition to memory impairment, occurs in AD. Kramer et al. [12] reported that the amnestic type of mild cognitive impairment, which has a high rate of progression to dementia, was accompanied by impaired attention and executive function disorders. We performed a desk study, which involved scoring IADLs and examining factors affecting them, and found that constructional ability, working memory, executive function, and memory all influenced IADLs [13]. In accordance with these findings, we hypothesized that the cognitive impairment (including impairment of visuospatial cognition, attention, working memory, executive function, and memory) described in previous studies would exert a direct influence on IADLs in AD.

In addition, depression is common in people with AD and has been found to affect IADL. In Japan in particular, mild AD is frequently accompanied by depression [14], which leads to motivational (volitional) decline; therefore, it is reasonable to speculate that it affects IADL performance.

There are several methods, including the Alzheimer’s Disease Cooperative Study IADL scale [6], Frenchay Activities Index (FAI) [15, 16], and Tokyo Metropolitan Institute of Gerontology Index of Competence [17], available for use in evaluating IADLs in elderly individuals and people with AD. Moreover, the FAI has been used to evaluate IADLs in elderly individuals and people with various diseases [18–21]. These IADL scales include all “housework” and “outdoor activities.” Therefore, both cognitive function and bodily function are likely to influence IADL in people with AD.

There are currently three main types of support available for Japanese people with mild AD: (a) drug therapy; (b) treatment of secondary symptoms to maintain psychological security; and (c) use of social services including those provided via long-term care insurance. However, few studies have been conducted to examine the adequacy of these types of ADL support for people with mild AD, who usually live at home, or the factors responsible for specific IADL difficulties. Because there are few reports that describe the relationship between functional impairment and IADL disability of AD patients. This information would be invaluable for those who provide IADL support and could help in the selection of useful assessment methods. Therefore, we sought to identify factors related to cognitive, psychological, and physical functioning affecting IADLs in elderly people with mild AD and individuals without dementia (i.e., non-dementia [ND] group).

Method

Subjects

The study included 54 subjects: 23 with mild AD and 31 no dementia (Table 1). The mild AD group included patients who were diagnosed with AD by psychiatrists or neurologists during an outpatient examination and undergoing ambulatory rehabilitation at one of three health centers for the elderly. Rehabilitation staff determined whether the mild AD group had very mild or mild dementia, using the Clinical Dementia Rating scale (i.e., scores of 0.5 or 1 respectively). Subjects with a history of other central nervous system diseases were excluded from the study. The 23 subjects in the mild AD group were all local community residents.

The ND group included 31 elderly people enrolled in aged-care prevention classes (i.e., classes that teach

| Table 1. Characteristics of the subjects | ND group | mild-AD group | t-test | p-value |
|---|---|---|---|---|
| Age (year) | 76.7 ± 6.0 | 79.9 ± 7.1 | < 0.001 | n.s. |
| MMSE | 28.32 ± 1.68 | 20.65 ± 3.58 | 0.5 or 1 | - |
| CDR | 0 | 0.5 or 1 | - | - |

ND; Non-Dementia Elderly persons AD; Alzheimer’s disease CDR; Clinical Dementia Rating
older adults to prevent the onset of problems necessitating home-based care). We excluded individuals with Mini-Mental State Examination scores of < 24 or a history of other central nervous system diseases. ND group members who met the selection criteria were volunteers at one of two health centers for the elderly or participants in aged-care prevention classes at one of three sites. All subjects in both groups were able to walk independently or with the assistance of a T-cane.

All subjects received written descriptions of the study and provided written informed consent. People with AD had previously listened to oral descriptions of the study, provided by a family member or caregiver. The study was approved by the research ethics committee at the university with which the first author was affiliated (Approval No. 2010C0018).

**IADL Evaluation Methods**

IADLs were evaluated using the Japanese version of the FAI, or Self-Rating FAI (SR-FAI) [22]. We used the SR-FAI because it provides a number of IADL categories and is therefore a sensitive measure of IADLs and better suited to examination of specific influential factors. Holbrook and Skilbeck [16] described a three-factor structure for the original FAI: domestic chores, leisure/work, and outdoor activities (Table 2).

The SR-FAI includes 15 items pertaining to IADLs, such as walking and employment activities, divided between three subscales. Although the items are scored using a scale ranging from 1 to 4 in the original FAI, the scale in the SR-FAI ranges from 0 to 3; therefore, total scores differ between the two versions [16, 22]. It should be noted that the factor structure for the Japanese version has not been validated. In addition, the SR-FAI was amended, resulting in differences in scale ranges (either from 1 to 4 or from 0 to 3) according to item [22]. The original SR-FAI (prior to amendment) was used to identify predictors in the original FAI’s three-factor structure, as it was closer to the original scoring method; in addition, we recalculated scores to reflect a scale range of 1 to 4 rather than 0 to 3. The score stage is not different from an original FAI in between an SR-FAI.

| Table 2. Comparison of the Original Frenchay Activities Index (FAI) and The Self-Rating Frenchay Activities Index |
|-------------------------------------------------|-------------------------------------------------|
| | **Original FAI** | **SR-FAI** |
| **Activities** | **Score** | **Score** |
| Preparing main meals (Preparing meals) | 1−4 a* | Preparing meals | 0−3 |
| Washing-up (Washing dishes) | 1−4 a* | Washing dishes | 0−3 |
| Washing clothes | 1−4 b* | Washing clothes | 0−3 |
| Light housework (Dusting/Vacuum cleaning) | 1−4 b* | Dusting/Vacuum cleaning/Clear up | 0−3 |
| Heavy housework (Cleaning) | 1−4 b* | Heavy housework (hanging up futon bedding for airing and taking it down, cleaning floors) | 0−3 |
| Domestic chores total points | 5−20 |
| Social outings | 1−4 b* | Social outings | 0−3 |
| Pursuing active interest in hobby (Hobby/sport) | 1−4 b* | Pursuing active interest in hobby (Hobby/sport) | 0−3 |
| Outings/car rides | 1−4 c* | The use of public transport (bicycle, car, bus, airplane) | 0−3 |
| Household and/or car maintenance | 1−4 d* | Household and/or car maintenance | 0−3 |
| Gainful work (Employment) | 1−4 f* | Gainful work (Employment) | 0−3 |
| Leisure/work total points | 5−20 |
| Walking outdoors > 15 min. | 1−4 b* | Walking outdoors > 15 min. | 0−3 |
| Driving a car/travel on bus | 1−4 b* | Driving a car/travel on bus, airplane etc. | 0−3 |
| Gardening | 1−4 d* | Gardening | 0−3 |
| Reading books | 1−4 e* | Reading books | 0−3 |
| Local shopping | 1−4 b* | Shopping | 0−3 |
| Outdoor total points | 5−20 |
| Total points | 15−60 | 0−45 |

FAI code

- a* 1 = Never, 2 = Under once weekly, 3 = 1−2 time a week, 4 = Most days
- b* 1 = Never, 2 = 1−2 times in 3 months, 3 = 3−12 times in 3 months, 4 = At least weekly
- c* 1 = Never, 2 = 1−2 times in 6 months, 3 = 3−12 times in 6 months, 4 = At least weekly
- d* 1 = None, 2 = Light, 3 = Moderate, 4 = All necessary
- e* 1 = None, 2 = in 6 months, 3 = Less than 1 a fortnight, 4 = Over 1 a fortnight
- f* 1 = None, 2 = Up to 10 h/week, 3 = 10−30 h/week, 4 = Over 30 h/week

The codes of Original FAI and SR-FAI are the same.
Therefore, as 0–3 points were awarded, the method used to recalculate scores added a point. The SR-FAI was administered to subjects in the ND group via face-to-face interviews with the first author, and AD group of family members were asked to complete SR-FAI forms.

Neuropsychological, Depression, and Physical Function Tests

We used the following tests to identify predictors of IADLs. The neuropsychological evaluation included measurement of attentional functioning, memory, visuospatial cognitive function/constructional function, and executive function. Attentional functioning was measured using the backward digit span and mental control tasks, which were Wechsler Memory Scale-Revised (WMS-R) subtests. Memory was assessed using logical memory II, which is also a WMS-R subtest. Visuospatial cognitive/constructional function was measured using the clock-drawing test. Executive function was measured using the Behavioural Assessment of the Dysexecutive Syndrome (BADS).

The WMS-R logical memory II subtest was selected because it is a delayed-recall memory test and therefore appropriate for detecting anterograde amnesia, a major AD symptom. The scoring criteria established by Rouleau, Salmon, Butters, Kennedy, and McGuire [23], which involve an 11-step evaluation with scores ranging from 0 to 10, were used to score the clock-drawing test. Concerning the BADS, a floor effect was confirmed for the Zoo Map Test. Specifically, the entire mild AD group exhibited low scores; therefore, the test was excluded. Total scores for the remaining tests (rule shift cards, action program, key search, temporal judgment, and modified six element tests) were included in the analysis, with a highest possible score of 20 for each test.

The Geriatric Depression Scale-15 (GDS-15) was used to screen for depression. This is a simple test, for which responses of “yes” or “no” are provided. Total scores range from 0 to 15, with scores of 0–5 and ≥ 6 indicative of no depression and depression, respectively.

As some SR-FAI items assess outside walking ability or repeated changes in direction and movement within a narrow area while cleaning, we used the Timed Up and Go (TUG) test to measure physical function, because it is a balance test and evaluates walking and changes in direction. Specifically, the TUG test measures the time required to rise from a seated position, walk for 3 m, return to the seat, and sit down. A stopwatch was used to record TUG test times, in seconds.

Data Analysis

We performed between-group comparisons using t tests or the Mann-Whitney U test ($p < 0.05$) to determine differences in WMS-R, the clock-drawing test, BADS, GDS-15, TUG test, and SR-FAI scores between the mild AD and ND groups. We also used the Shapiro-Wilk test as the normal distribution test. In addition, we examined factors influencing SR-FAI scores (WMS-R, clock drawing test, BADS, GDS-15, TUG test), using multiple regression analysis with the three SR-FAI subscale scores as dependent variables after cancellation of the two groups. Age, sex (male = 1, female = 2), neuropsychological test and GDS-15 scores, and TUG test performance (in seconds) were included as independent variables.

We then performed multiple regression analysis using the stepwise method, with independent variables ($p < 0.05$).

All statistical analyses were performed using IBM SPSS Statistics Ver. 21 (IBM Corp., Armonk, NY).

Results

Result of the normality test

As a result of the Shapiro-Wilk test, no normal distribution was found in the results of WMS-R mind-control tasks, WMS-R digit span backward, WMS-R logical memory II, the clock drawing test, and GDS-15. However, for BADS, the TUG test, and SR-FAI, normality was recognized.

Between-Groups Comparison

Table 3 shows the results of the between-groups comparison of SR-FAI scores and other variables. GDS-15 scores did not differ significantly between groups. However, SR-FAI, neuropsychological test, and TUG test scores in the mild AD group were significantly lower relative to those of the ND group ($p < 0.05$).

Multiple Regression Analysis

To ensure that we avoided multicollinearity between independent variables, we calculated the variance inflation factor, which was < 3.0; therefore, multicollinearity was assumed to be under control (Table 4). Risk factors for the domestic chores subscale included backward digit span ($\beta = 0.42$, $p < 0.001$) and TUG test ($\beta = -0.42$, $p < 0.001$) performance and sex ($\beta = -0.26$, $p < 0.001$). The weight determination coefficient by these factors was $R^2 = 0.56$; root mean square error was 4.40. Risk factors for the leisure/work subscale included backward digit span ($\beta = 0.22$, $p = 0.029$), logical memory II ($\beta = 0.29$, $p = 0.01$), and TUG test ($\beta = -0.23$, $p = 0.017$) performance and total BADS score ($\beta = 0.31$, $p = 0.008$). The weight determination coefficient by these factors was $R^2 = 0.66$; root mean square error was 2.69. Risk factors for the outdoor activities subscale included...
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ed backward digit span (β = 0.35, p = 0.001), logical memory II (β = 0.28, p = 0.009), and TUG test (β = 0.38, p < 0.001) performance. Further, the weight determination coefficient by these factors was $R^2 = 0.62$; root mean square error was 3.15.

**Discussion**

The study identified factors (i.e., sex and cognitive, neuropsychological, and physical functioning) that predicted IADL performance (as measured via the three SR-FAI subscales) in people with mild AD or no dementia. Notably, the contributions made by the variables to the variance in the three SR-FAI subscale scores were as follows: domestic chores: $R^2 = 0.53$, leisure/work: $R^2 = 0.66$, and outdoor activities: $R^2 = 0.62$. Therefore, they explained a substantial proportion of the variance.

Factors predicting domestic chore scores included backward digit span and TUG test performance and sex. The domestic chores subscale represents habitual household tasks performed regularly by subjects for many years. Therefore, working memory (i.e., backward digit span performance) and balance (i.e., TUG test performance) naturally contributed to performance of these tasks. The inclusion of meal preparation and cleaning as domestic chores could explain why sex was identified as a risk factor, as women perform approximately 80% of these domestic chores in Japan [24]. Here, we noticed that cultural differences existed in the original FAI and SR-FAI’s heavy housework, which includes “hanging up futon bedding for airing and taking it down, cleaning floors” (Table 2). In Japan, such housework is often done by old women. Therefore, there is a possibility that the heavy housework chores in Japan have further

**Table 3.** Results of each evaluation and SR-FAI

| Evaluation Type          | ND group Mean ± SD | mild-AD group Mean ± SD | p-value |
|--------------------------|--------------------|-------------------------|---------|
| Executive function test  | BADS               | 13.5 ± 2.6              | 7.2 ± 2.5 | 31 n = 7.73 ± 0.001 |
| Balance test             | Timed Up and Go test | 11.2 ± 12.7            | 17.2 ± 5.6 | * 0.001 |
| SR-FAI                   | Domestic chores    | 13.1 ± 4.7              | 7.5 ± 4.6 | *** 0.001 |
|                         | leisure/work      | 14.5 ± 2.9              | 7.4 ± 2.3 | *** 0.001 |
|                         | Outdoors          | 15.3 ± 3.4              | 8.2 ± 3.7 | *** 0.001 |
| Attentional function test| WMS-R mind-control tasks | 5.13 ± 0.16          | 3.3 ± 2.3 | *** 0.001 |
|                         | WMS-R digit span backward | 6.5 ± 1.9            | 4.2 ± 1.5 | *** 0.001 |
| Memory test             | WMS-R Logical Memory II | 13.4 ± 9.0            | 0.3 ± 0.8 | *** 0.001 |
| Visuospatial cognitive function/ | Clock Drawing Test | 9.4 ± 1.5            | 6.7 ± 2.4 | ** 0.001 |
| Constructional function test | GDS-15            | 3.0 ± 2.6              | 3.0 ± 2.3 | n.s 0.001 |

**Table 4.** Impact factor of FAI; Result of multiple regression analysis

| Dependent variable | Independent variable | Standard β | t  | p-value |
|--------------------|----------------------|------------|----|---------|
| Domestic chores    | Gender               | 0.25       | 2.68 | 0.001   |
|                    | WMS-R digit span backward | 0.42       | 3.91 | < 0.001 |
|                    | Timed Up and Go test  | −0.42      | −4.02 | < 0.001 |
| leisure/work       | WMS-R digit span backward | 0.22       | 2.24 | 0.029   |
|                    | WMS-R Logical Memory II | 0.29       | 2.47 | 0.017   |
|                    | BADS                 | 0.31       | 2.78 | 0.008   |
|                    | Timed Up and Go test  | −0.23      | −2.48 | 0.017   |
| Outdoors           | WMS-R digit span backward | 0.35       | 3.42 | 0.001   |
|                    | WMS-R Logical Memory II | 0.28       | 2.70 | < 0.001 |
|                    | Timed Up and Go test  | −0.38      | 3.99 | 0.50    |

VIF; Variance Inflation Factor  
WMS-R; Wechsler Memory Scale-Revised  
BADS; The Behavioural Assessment of the Dysexecutive Syndrome
extracted gender as a risk factor.

The leisure/work subscale showed slightly different risk factors, including BADS scores and logical memory II, backward digit span, and TUG test performance. Leisure/work IADLs involve social outings, hobby-related activities, and gainful employment. Relative to domestic chores, leisure/work IADLs are less habitual and require planning and predictive skills (i.e., the ability to foresee results). Therefore, delayed recall memory (i.e., logical memory II performance) and executive function (i.e., BADS score) are likely to be required for these activities.

Furthermore, outdoor activities subscale scores were predicted by logical memory II, backward digit span, and TUG test performance; these results suggest that attention, working memory, and delayed recall memory all exerted a strong influence on outdoor activities. Notably, BADS scores did not predict outdoor activities, which include driving, riding on a bus, and shopping, even though executive function is likely to be required for such tasks.

This result shows that leisure/work requires more performing executive function than outdoor activities. Also, logical memory II (delayed recall memory) and backward sounding (attention and working memory) are the basic elements of the execution function. From these facts, in the case of the outdoor activities, there is a possibility that attention, working memory, and recall memory, which is the foundation element of outdoor activities, has a stronger influence than the execution function.

Piquard et al. reported that there was no correlation between IADL scores of AD patients and BADS score [25]. Monaci et al. reported that AD patients initially recognized an association between the executive functions scale and the IADL scale but that there was no association after 18–24 months [26].

From these facts, when investigating factors affecting IADL of AD patients, it may be better to use the fundamental elements of executive functions (such as attention and working memory) rather than BADS. Furthermore, the influence of the relationship between IADL and executive functions may be lowered depending on the degree of progression of AD symptoms. The current result also showed that the outdoor activities in IADL may indicate that it is an activity that causes the executive functions function to disappear from early on.

TUG test performance was identified as a common risk factor for all three SR-FAI subscales. It is likely that TUG test performance influenced domestic chores because they involve mainly indoor household tasks, such as meal preparation and doing laundry, and performance of these chores within the narrow spaces in Japanese homes necessitates numerous changes in direction and posture (from squatting to standing), requiring good balance. Leisure/work and outdoor activities both include movements over a broad area; therefore, good walking ability and directional changes (both assessed via the TUG test) would be required for these activities.

Another possible reason for identification of TUG test performance as a risk factor for all three types of IADL is that cognitive functioning could influence physical functioning, as suggested by the finding that the mild AD group’s TUG test performance was significantly worse relative to that of the ND group (Table 3). In a study involving people with mild cognitive impairment, McGough et al. [27] found that TUG test performance was associated with cognitive function, and Voelcker-Renhave, Godde, and Staudinger [28] reported strong relationships between fitness in exercises requiring speed, balance, and fine motor coordination, and executive function and perception speed, which are related to activity in the frontoparietal network. Moreover, lower levels of activity in the temporal lobe’s inner surface, posterior cingulate gyrus, and parietal cortex have been reported in individuals with mild AD [29,30], but motor activity impairment has not been observed during the early stages.

However, it is possible that deterioration of parietal function in mild AD influenced TUG test performance via mediation of the frontoparietal network. In other words, cognitive decline could have affected IADL indirectly via physical function (i.e., TUG test performance).

Age was not significantly associated with any of the FAI factors. Although aging is associated with both physical and cognitive decline, the results indicated that it did not exert an independent effect on IADLs beyond an indirect influence exerted via cognitive and physical function.

Because motivational (volitional) decline could also affect IADLs, the GDS-15 was used to screen for depression; however, the results showed that depression did not affect IADLs. This could have been because people with severe depression were not included in the sample (Table 3).

Overall, the results indicate that the factors influencing IADLs in the ND and mild AD groups differed according to IADL category. The results regarding neuropsychological tests (i.e., working memory, delayed recall memory, and executive function) are consistent with those of Albert, Moss, Tanzi, and Jones [31], who reported that verbal and auditory memory tasks, the Part B of the Trail Making Test for executive function, and the backward digit span test were all indices of progression from health to mild AD. The study was novel in that it demonstrated the ways in which the effects of
cognitive function on IADLs differed according to IADL category, suggesting that certain cognitive functions could be prioritized during IADL-related rehabilitation. Furthermore, the finding that TUG test performance influenced all three SR-FAI subscales indicates that walking balance was important in IADLs (or that cognitive function influenced walking balance) in both groups. Therefore, it is worthwhile to evaluate both cognitive function and walking/balance in elderly individuals participating in dementia-prevention activities or receiving home-based care for AD. The neuropsychological tests and TUG should be used to evaluate daily support services, and the results could assist doctors and therapists in determining necessary services for patients.

**Study Limitations and Future Recommendations**

One of the limitations of this study was that the subjects were ambulatory rehabilitation patients or participated in aged-care prevention classes, at three health centers for the elderly. Therefore, the results might not be generalizable to ambulatory patients at other institutions or elderly residents in other areas.

Rapcsak, Croswell, and Rubens [32] and Okazaki, Kasai, Meguro, Yamaguchi, and Ishii [33] reported that IADL performance in individuals with AD was affected by executive function and apraxia. Moreover, Grossi, Becker, Smith, and Trojano [34] found that attention-allocation disorders arose in individuals with AD because of a reduction in their ability to perceive stimuli simultaneously. Therefore, another limitation of the study was that apraxia and attention-allocation disorders were not considered, even though there appears to be sufficient evidence to warrant examination of cognitive disorders affecting IADL performance. In addition, we did not consider apathy, which could lead to reductions in motivation and interest in performing IADLs. Furthermore, the study was biased in terms of sex, as the sample included 44 women and only 10 men, which could have affected the results. Future research is required to clarify the effects of apraxia, attention-allocation functions, depression, apathy, and sex differences in IADL.

**Conclusion**

Overall, the results indicated that the effects of the cognitive and physical function variables differed according to IADL type. The finding that TUG test performance was related to all IADL types could have occurred because it is sensitive to cognitive impairment or exerted a strong direct effect on IADLs in a general sense. Evaluations and interventions that involve the cognitive and physical functions identified in this study could be beneficial in activity planning for the provision of IADL support to individuals with mild AD or no dementia in aged-care prevention classes and ambulatory rehabilitation.

**Conflicts of Interest**

The authors have no conflicts of interest to declare.

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