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Conflict of Interest

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Gender Differences in Items of the Instrumental Activities of Daily Living in Mild Cognitive Impairment and Alzheimer's Disease Dementia

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ABSTRACT

Background and Purpose: Each item in the instrumental activities of daily living (IADL) questionnaire has differential importance to an individual's life functioning based on gender. However, IADL has mostly been utilized for its total score alone, without gender specificity. We identify the impact of each item on the transition from amnesic mild cognitive impairment (aMCI) to Alzheimer's disease dementia (ADD), and determine if the impact of each item differs by gender.

Methods: Subjects were aMCI or ADD with a global clinical dementia rating of 0.5 or 1. The sample size was 146 men and 154 women. We used logistic regression analysis to determine the effect of each item of IADL on the transition from aMCI to ADD.

Results: The odds ratio (OR) for "remembering recent events" had similar values: 27.2 for men, and 27.7 for women. Gender difference was identified in the item with the highest OR value. For women, the "using transportation" item was 63.3, and for men, "conducting financial affairs" was overwhelmingly high at 89.1.

Conclusions: Functional decline on items with relatively higher ORs may indicate higher probability of a transition from aMCI to ADD. The OR of "conducting financial affairs" was relatively higher for both genders. In terms of gender differences, "conducting home repair" for men, and "using transportation" for women, have relatively higher impact. This study demonstrates that during the transition from aMCI to ADD, each item of IADL shows a staggered decline in functioning, and that this decline is gender-specific.

Keywords: Neurocognitive Disorders; Dementia; Sex Factors; Mild Cognitive Impairment; Activities of Daily Living

INTRODUCTION

The activities of daily living (ADL) is a concept that encompasses the fundamental skills needed for independent personal management at both basic and complex levels. In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders, significant impairment in ADL independence is one of the key criteria for the diagnosis of dementia.¹ The ADL can be categorized into the basic ADL (BADL), such as bathing, dressing, and toileting, and the

instrumental ADL (IADL), which are more complex activities, such as managing finances, and engaging in hobbies.²⁻⁴

While most items of the BADL are primarily related to self-care abilities and are rarely affected by gender, some items of the IADL are based on the social and cultural roles of the individual, and it is difficult to exclude the influence of gender. As one of the traditional IADL questionnaires, the early version of the Lawton IADL,⁴ the items “food preparation”, “housekeeping”, and “laundry” were designed for women subjects only. The Korean version of the Lawton IADL⁵ was designed so that men would also respond to these items. On the other hand, the Korean IADL (K-IADL),^{6,7} which was developed by modifying the Lawton IADL to suit the Korean context, is designed to allow both men and women to respond to all items, while adding an “irrelevant” option for each item to reflect individual differences, including gender-related roles. Selecting the “irrelevant” option based on individual characteristics means that the weight of each item in the total score will differ from individual to individual. In addition, if a particular item has a significantly lower response by gender due to the functional roles of men and women in a culture, it may be necessary to make adjustments to the question based on gender. Therefore, it is important to look closely at the degree of response to the question by gender.

On the other hand, the IADL addresses functional skills that are based on more complex cognitive abilities, compared to the BADL. Maintaining the independence of the IADL in mild cognitive impairment (MCI) often requires greater effort or compensatory strategies.¹ The Petersen criteria for MCI states that all subtypes of clinical MCI must not meet the criteria for dementia, but that mild impairment in functional activities is possible.⁸ Some studies have shown that a mild decline in the IADL is also seen in the MCI stage.^{9,10} One paper comparing normal control and MCI showed group differences in conversation, household activities, medication, social functioning, telephone, and organization.¹¹ The finding that the IADL can show deterioration as early as MCI suggests that the IADL may provide useful information in identifying early dementia.¹² Therefore, in clinical practice, the IADL has been utilized for diagnosing early dementia, clinical follow-up, and treatment evaluation.

While the overall score is important in assessing an individual's IADL, the individual items of the IADL are also important. Furthermore, each IADL item may have different importance for practical interventions to improve a patient's life functioning. Previous studies have reported that among IADL items, telephone use, use of transport, medication intake, and financial management are strong predictors of developing dementia.¹³⁻¹⁵ A related study found that among Telephone, Transportation, Medications, and Finances, Finances had the highest odds ratio (OR) for predicting dementia 10 years later.¹⁶

On the other hand, when it comes to the gendered nature of IADL, most existing studies have analyzed IADL without distinguishing between genders. Research on the gender-specificity of IADL items is rare, and findings on the risk of dementia by gender in IADL are inconsistent. While some studies have shown that IADL and dementia risk do not differ by gender,¹⁷ others have reported that poor IADL functioning is associated with increased dementia risk in men, but not in women.¹⁸ These studies analyzed gender differences in IADL, but they are limited, in that they do not report the gender-specific characteristics of the individual IADL.

In this study, we aimed to find out how amnesic MCI (aMCI) and Alzheimer's disease dementia (ADD) differ based on gender in the IADL items, as follows: first, we determine

if there is a difference between men and women in the percentage checked as unrelated for each item. Second, for each item, we determine if there is a gender difference in the optimal cut-off score that separates ADD from aMCI. Lastly, we identify the impact of each item on the transition from aMCI to ADD, and compare them to determine if the impact of the items differs by gender.

METHODS

Study participants

Subjects were patients diagnosed with aMCI or ADD with a global clinical dementia rating (CDR) of 0.5 or 1 who visited the Department of Neurology at Konkuk University Medical Center between October 2021 and July 2023, and who underwent neuropsychological evaluation. The clinical assessment for dementia diagnosis was made by a neurologist, while the Korean version of the Mini Mental State Examination, 2nd edition (K-MMSE-2)^{19,20} and the CDR²¹ were administered by a neuropsychologist. The final sample size, excluding those with no education, was 300, of which 146 were men, and 154 were women. For the clinical diagnosis of aMCI, the Petersen criteria⁸ were used. The clinical diagnosis for ADD was based on the criteria of the National Institute on Aging-Alzheimer's Association workgroups, published in 2011.²²

Materials

The K-IADL was used to evaluate the IADL. The K-IADL was developed and standardized in 2002, and re-standardized in 2018.^{6,7} This is an 11-item caregiver-reported questionnaire. The 11 items consist of the following topics: 1. shopping; 2. using transportation; 3. conducting financial affairs; 4. housekeeping; 5. preparing food; 6. using the telephone; 7. taking medicine; 8. remembering recent events; 9. enjoying hobbies; 10. watching TV; 11. conducting home repair. Each item has five choices: "possible alone" (0 point), "need some help" (1 point), "need a lot of help" (2 points), "impossible alone" (3 points), "irrelevant" (exclude). The K-IADL score is obtained by dividing the sum of the item scores by the number of items assessed, excluding those rated as irrelevant. Therefore, the score ranges (0–3). In analyzing each item, irrelevant rates were excluded from the final analysis. In addition to the K-IADL, the K-MMSE-2 was administered for the assessment of general cognition, and the CDR and CDR-sum of boxes (CDR-SB) were performed for dementia severity evaluation.

Procedures

During the detailed neuropsychological assessment of patients, the K-IADL was provided along with other questionnaires to be filled out by caregivers. Since the study is data-gathering research, the review exemption was approved by the Konkuk University Medical Center Institutional Review Board (IRB No. KUMC 2024-01-052).

Statistical analysis

To examine demographic differences in the gender group, Student's *t*-test was used for age, education, K-MMSE-2, CDR, CDR-SB, and K-IADL. Chi-square analysis was used for gender comparison of the proportion of "irrelevant" responses for each item. For each item, receiver operating characteristic curve analysis was performed to determine the optimal cut-off score distinguishing ADD from aMCI, and optimal cutoff scores are presented. The effects of individual K-IADL items were analyzed based on gender, using the logistic regression method for the aMCI and ADD groups. The diagnosis group was set as the dependent variable, and

the score of each item categorizing it into two based on the optimal cut-off score was set as an independent variable. Age and education variables were included as covariates. In the analysis, a p -value<0.05 was considered statistically significant. The data were analyzed using IBM SPSS 25.0 statistical software (IBM Corp., Armonk, NY, USA).

RESULTS

In the analysis of differences by gender group, there were no significant differences in age, CDR, CDR-SB, and K-IADL score, but there were significant differences in education and K-MMSE-2 score (**Table 1**). The CDRs for the aMCI group were all 0.5, while those for the ADD group were either 0.5 or 1.

When we analyzed the “irrelevant” response for each item, men had significantly higher percentages of “irrelevant” responses than women for four items: “shopping”, “conducting financial affairs”, “housekeeping”, and “preparing food”. Women had a significantly higher percentage of “conducting home repair” responses than men (**Table 2**). We found that almost all items had less than 50% “irrelevant” responses, except for “preparing food” and “conducting home repair”. Items “using the telephone”, “taking medicine”, “remembering recent events”, and “watching TV” had less than 2% “irrelevant” responses for both men and women subjects. Items “using transportation” and “enjoying hobbies” had less than 10%.

Table 1. Demographic characteristics of the participants

Variables	aMCI (n=136)				ADD (n=164)			
	Men	Women	t-test*	Sig.	Men	Women	t-test*	Sig.
No. (%†)	68 (46.6)	68 (44.2)	N/A	N/A	78 (53.4)	86 (55.8)	N/A	N/A
Age	76.78±6.57	75.79±7.67	-0.80	0.423	79.05±7.53	79.56±7.31	0.44	0.663
Education (yr)	11.41±4.52	9.00±3.23	-3.58	<0.001	12.12±4.12	8.30±3.69	-6.25	<0.001
K-MMSE-2	26.78±2.18	26.31±2.12	-1.28	0.204	21.77±3.52	19.83±3.13	-3.75	<0.001
CDR	0.5‡	0.5‡	N/A	N/A	0.80±0.25	0.80±0.25	0.19	0.847
CDR-SB	1.61±0.79	1.42±0.73	-1.47	0.144	5.11±1.68	5.29±1.83	0.67	0.511
K-IADL	0.29±0.19	0.29±0.19	0.15	0.878	1.30±0.59	1.43±0.65	1.31	0.193

Values are presented as the mean±standard deviation.

aMCI: amnesic mild cognitive impairment, ADD: Alzheimer’s disease dementia, Sig.: significant difference, N/A: not available, K-MMSE-2: the Korean version of Mini Mental State Examination, 2nd edition, CDR: clinical dementia rating, CDR-SB: clinical dementia rating-sum of boxes, K-IADL: Korean-instrumental activities of daily living.

*Compared with Student’s t -tests; †The % represents the ratio of MCI or AD in each gender; ‡The CDR for all MCIs is 0.5 points.

Table 2. Gender-specific “irrelevant” choice percentage per item

Items	aMCI			ADD		
	Men	Women	p -value*	Men	Women	p -value*
Shopping	10.3	1.5	0.029	14.1	1.2	0.001
Using transportation	1.5	7.4	0.095	2.6	4.7	0.477
Conducting financial affairs	11.8	1.5	0.016	16.7	5.8	0.026
Housekeeping	27.9	0	<0.001	43.6	0	<0.001
Preparing food	82.4	1.5	<0.001	85.9	4.7	<0.001
Using the telephone	1.5	0	0.316	1.3	1.2	0.945
Taking medicine	1.5	0	0.316	0	0	N/A
Remembering recent events	0	0	N/A	0	0	N/A
Enjoying hobbies	4.4	2.9	0.649	3.8	7	0.379
Watching TV	0	1.5	0.316	1.3	1.2	0.945
Conducting home repair	20.6	83.8	<0.001	30.8	87.2	<0.001

Values are presented as percentages.

aMCI: amnesic mild cognitive impairment, ADD: Alzheimer’s disease dementia, N/A: not available.

* χ^2 tests were used.

In particular, the item “remembering recent events” had zero “irrelevant” responses across all participants. However, in both diagnostic groups, “food preparation” for men and “home repair” for women had less than 80% “irrelevant” rate.

The optimal cut-off score distinguishing between aMCI and ADD was determined by maximizing both the sensitivity and specificity for each item (**Table 3**). The optimal cut-off score was found to be 1 for almost all items in both men and women, while 2 for the item “recent memory” in both genders. Additionally, the optimal cut-off of the total K-IADL score for men was 0.52 (area under the curve [AUC], 0.964; sensitivity, 0.923; specificity, 0.911), while for women, it was 0.58 (AUC, 0.975; sensitivity, 0.942; specificity, 0.911).

When logistic regression was performed for each gender, the ORs of all items were significant, and the influence of each item differed between men and women (**Table 4**). In common for men and women, “shopping” had a relatively lower OR, while “remembering recent events” and “conducting financial affairs” had a relatively higher OR. The OR for the item “remembering recent events” had similar values: 27.2 for men, and 27.7 for women. In terms of differences between men and women, the lowest ORs were “shopping” for men, and “taking medicine” for women, respectively. In particular, gender difference was identified in the item with the highest OR value. For women, the “using transportation” item was 63.3, and for men, “conducting financial affairs” was overwhelmingly high at 89.1.

Table 3. Gender-specific optimal cut-off scores

	Men (n=146)				Women (n=154)			
	AUC	Cut-off	Sensitivity	Specificity	AUC	Cut-off	Sensitivity	Specificity
Shopping	0.822	1	0.836	0.721	0.847	1	0.871	0.627
Using transportation	0.856	1	0.816	0.791	0.927	1	0.915	0.841
Conducting financial affairs	0.927	1	0.923	0.883	0.931	1	0.938	0.806
Housekeeping	0.773	1	0.591	0.939	0.825	1	0.709	0.912
Preparing food	0.886	1	0.818	0.833	0.880	1	0.878	0.791
Using the telephone	0.797	1	0.701	0.866	0.812	1	0.729	0.853
Taking medicine	0.863	1	0.910	0.612	0.841	1	0.872	0.603
Remembering recent events	0.809	2	0.667	0.926	0.853	2	0.791	0.882
Enjoying hobbies	0.840	1	0.813	0.800	0.827	1	0.763	0.818
Watching TV	0.811	1	0.753	0.824	0.847	1	0.788	0.866
Conducting home repair	0.857	1	0.759	0.926	0.760	1	0.636	0.818

AUC: area under the curve.

Table 4. Gender comparison of the impact of individual K-IADL items on diagnosis

Men (ascending order)		Women (ascending order)	
K-IADL items	OR (95% CI)	K-IADL items	OR (95% CI)
#1. Shopping	13.3 (5.5–32.1)	#7. Taking medicine	9.0 (4.0–20.3)
#10. Watching TV	14.4 (6.3–33.2)	#1. Shopping	10.2 (4.5–23.3)
#6. Using the telephone	14.6 (6.2–34.5)	#9. Enjoying hobbies	14.7 (6.0–36.1)
#7. Taking medicine	15.7 (6.1–40.1)	#6. Using the telephone	14.5 (6.3–33.6)
#2. Using transportation	16.2 (6.9–37.8)	#10. Watching TV	24.3 (9.8–60.5)
#9. Enjoying hobbies	17.5 (7.3–41.9)	#4. Housekeeping	26.1 (9.3–73.1)
#4. Housekeeping	25.6 (6.5–101.1)	#5. Preparing food	26.9 (10.6–68.5)
#8. Remembering recent events	27.2 (9.2–79.8)	#8. Remembering recent events	27.7 (10.9–69.9)
#11. Conducting home repair	38.2 (11.5–126.8)	#3. Conducting financial affairs	59.3 (19.2–182.7)
#3. Conducting financial affairs	89.1 (25.3–313.7)	#2. Using transportation	63.3 (20.3–197.6)
#5. Preparing food	N/A*	#11. Conducting home repair	N/A*

All p-value<0.001.

K-IADL: Korean-instrumental activities of daily living, OR: odds ratio, CI: confidence interval.

*Excluded with a non-response rate of less than 20%.

DISCUSSION

Regarding “irrelevant” choices for men and women, in the K-IADL development paper, only the “preparing food” item was the highest at 75.0% only for men, and the rest of the items did not exceed 35% for both men and women.⁶ In contrast, in this study, “preparing food” for men and “conducting home repair” for women had more than 80% “irrelevant” choices. Compared to a study 20 years ago, we believe that the social environment has changed, such that older women are significantly less likely to do home repairs themselves. The existence of these distinct gender-specific “irrelevant” items has the effect of making them act as gender-specific substitutes. On the other hand, when an activity is performed on an “irrelevant” item of the opposite gender, the weight of each item changes in calculating the total K-IADL score. If gender-specific “irrelevant” items are evident in future large-scale studies, as in this study, it may be necessary to separate the K-IADL items by gender in the future.

For both men and women, unlike the other items, the optimal cutoff score for the item “remembering recent events” was 2, indicating some level of impairment on this item already at the aMCI stage. The converse is that IADL items other than memory-related IADL are generally less likely to show functional decline in the aMCI stage. Thus, for individuals with AD-related MCI or dementia, non-memory IADL problems may indicate more severe functional decline than memory-related IADL, suggesting a more rapid transition to dementia.

To the best of our knowledge, there have been no studies on how individual IADL items differentially affect the development of dementia by gender. In the present study, we aimed to determine whether the effect of each item of the K-IADL on the transition from aMCI to ADD, based on the cut-off separating aMCI from ADD, differs by gender. We used the relative magnitudes of the ORs obtained through logistic regression to determine each item’s influence. The occurrence of functional decline on items with relatively higher ORs may indicate higher probability of a transition from aMCI to ADD. For men, the ORs for “conducting financial affairs” and “conducting home repair” were about 1.4 and 3.3 times higher, respectively, than for “remembering recent events”; for women, the ORs for “conducting financial affairs” and “using transportation” were about 2.1 and 2.3 times higher, respectively, than for “remembering recent events”. Also, the highest OR (“conducting financial affairs” for men, “using transportation” for women) was about 7.0 times that of the lowest (“shopping” for men, “taking medicine” for women), which was similar for men and women. The item “conducting financial affairs” had a relatively higher impact for both men and women. In terms of gender differences, the items “conducting home repair” for men and “using transportation” for women can be seen to have a relatively higher impact. In the end, for men, the most influential IADL item is “conducting financial affairs” with an OR of about 90, while for women, both “using transportation” and “conducting financial affairs” need to be emphasized at the same time. On the other hand, functional decline on items with relatively lower ORs may suggest a mix of the aMCI and ADD stages. For both men and women, the item “shopping” falls into this category. The items “watching TV” for men and “taking medicine” for women were relatively lower. These results provide gender-specific information about which IADL items to selectively observe and work to maintain focus on at each stage of cognitive decline.

Based on the above results, we can visualize how K-IADL items typically affect the aMCI and ADD stage (**Fig. 1**). Already in the aMCI phase, a degradation of the “remembering recent events” function is observed. In the transition to the ADD stage, functional decline is observed in “shopping” and “watching TV” for men, and “taking medicine” and “shopping” for

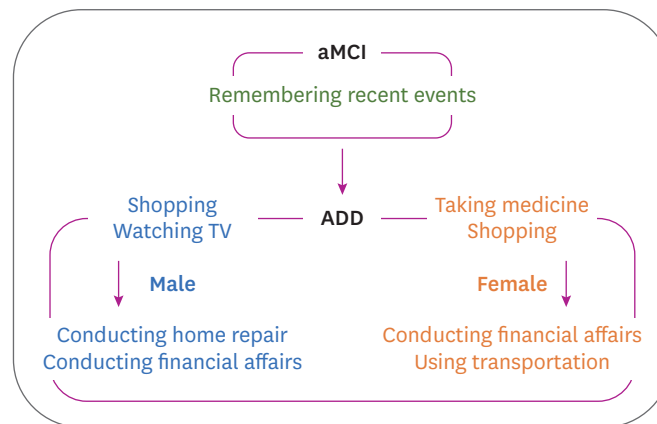


Fig. 1. Gender-specific flow of symptom reporting for key K-IADL items.
aMCI: amnesic mild cognitive impairment, ADD: Alzheimer's disease dementia, K-IADL: Korean-instrumental activities of daily living.

women. Declines in “conducting home repair” and “conducting financial affairs” for men and “conducting financial affairs” and “using transportation” for women may indicate an almost certain transition to dementia. Given that men are generally more likely to be responsible for home repairs than women, and that older women are more likely to be socially active than older men, the results of this study are a relatively good reflection of everyday life for men and women in general. This suggests that when diagnosing dementia for an individual patient, it is important to pay attention to which IADL items are important to the individual's daily life. We believe that such a diagram has the advantage of making caregivers and the patients in the early stages of decline aware of functions that should be clearly observed.

There are some limitations to this study. First, the number of subjects in the study is rather small to generalize about gender differences. Second, the geographic diversity of the subjects included in the study should be ensured to generalize the differences between genders. This study is limited by the fact that it only includes patients from a single hospital. Third, further research is needed to see if similar results are found for dementia groups other than ADD. Lastly, this study categorized gender by biological sex. With the recent individualization of gender roles, the importance of social gender as a gender role in addition to biological distinction is becoming more apparent. Therefore, we believe that social gender needs to be considered in IADL analysis in the future.

This study demonstrates that during the transition from aMCI to ADD, each item of the IADL shows a staggered decline in functioning, and that this decline is gender-specific. The similarities and differences between men and women identified in this study can be used as a useful resource for gender-specific approaches to diagnosing and preventing dementia, identifying the extent of functional decline, educating caregivers, and rehabilitation in various settings.

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