Original Article

Relationship between frontal assessment battery scores and activities of daily living/instrumental activities of daily living ability in older adults

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Abstract. [Purpose] The present study aimed to investigate the relationship between Frontal Assessment Battery scores and the ability to perform activities of daily living/instrumental activities of daily living based on child development, as well as the ability of Frontal Assessment Battery score to predict functional age. [Participants and Methods] The present cross-sectional study included 85 older adults (mean age: 83.5 years, standard deviation: 7.3; men: 23, women: 62; facility-dwelling: 43, home-based: 42) recruited from nursing homes and day centers in Hiroshima and Hyogo, Japan. All the participants were assessed using the Frontal Assessment Battery and perform activities of daily living/instrumental activities of daily living Cognitive Level Version 2.0 scale (ADL/IADL-COG ver.2.0). Spearman rank correlation coefficients and single regression analyses were performed to determine the relationship between the Frontal Assessment Battery score and functional age. The regression equation was then used to predict functional age based on the Frontal Assessment Battery score. [Results] We observed a strong correlation between the Frontal Assessment Battery score and functional age (rs=0.80). Furthermore, the linear regression equation for functional age exhibited a high predictive accuracy ($R^2=0.64$). Our results thus indicated that Frontal Assessment Battery scores could be used to predict functional age according to the following equation: functional age (years)$=0.56 \times$ Frontal Assessment Battery score $+ 1.19$ and Frontal Assessment Battery score$=1.15 \times$ functional age (years) $+ 1.86$. [Conclusion] The present results indicate a significant relationship between Frontal Assessment Battery and perform activities of daily living/instrumental activities of daily living ability based on child development. Functional age, as predicted based on the Frontal Assessment Battery score, may aid rehabilitation practitioners in analyzing the relationship between cognitive function and perform activities of daily living/instrumental activities of daily living ability, setting goals regarding perform activities of daily living/instrumental activities of daily living, and selecting intervention targets in older adults.

Key words: Frontal Assessment Battery (FAB), ADL, IADL

INTRODUCTION

As of October 1st, 2017, the proportion of adults aged 65 years or older in the total population of Japan was 27.3%$.1$ As this proportion is expected to increase in the near future, the number of older adults requiring nursing care/living with dementia is also expected to increase$.3$. Thus, urgent measures are required to address the growing needs of this population.

Cognitive impairment is among the main clinical diagnostic criteria for dementia$.3$, substantially interfering with activities of daily living (ADLs)/instrumental activities of daily living (IADLs). As the ultimate goal of occupational therapy is to support patients while they are engaged in various activities$.5$, it is important to determine the correlations among levels
of cognitive impairment and functioning during ADL/IADLs based on assessment results in older adults and patients with dementia.

Previous studies have reported a strong correlation between assessments of cognitive function and ADL/IADLs ability based on childhood development, suggesting that decreases in cognitive function occur in the reverse order of childhood development among older adults, not just those with dementia\(^5\)\(^{-10}\). Additional studies have revealed that functional age as predicted by the Mini-Mental State Examination (MMSE), Hasegawa’s Dementia Scale-Revised (HDS-R), and NM scale can be used as an indicator of cognitive function\(^8\)\(^{-10}\). However, although the Frontal Assessment Battery (FAB) is often used to screen for cognitive impairment in clinical practice, no such studies have examined FAB score as an indicator of cognitive function. Therefore, the present study aimed to investigate the relationship between FAB scores and ADL/IADLs ability based on child development, as well as the functional age to predict from the FAB score using regression equation.

**PARTICIPANTS AND METHODS**

The present cross-sectional study included 85 older adults recruited from nursing homes and day centers in Hiroshima and Hyogo, Japan (mean age: 83.5 years, SD: 7.3; men: 23, women: 62; facility-dwelling: 43, home-based: 42). Approval was obtained from the Research Ethics of the Kyushu Medical Sports Vocational School (approval no. 2016-01). This study obtained approval from the Declarations of Helsinki. Written informed consent was obtained from each participant or their family members prior to participation. The first author takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

Cognitive function was assessed using the FAB. The FAB is a short bedside cognitive and behavioral battery used to assess frontal lobe functions\(^11\). ADL/IADLs ability was assessed using Cognitive Level version 2.0 (ADL/IADL-COG ver.2.0), which is based on childhood development. The ADL/IADL-COG is a highly valid and reliable assessment consisting of 47 items used to determine developmental age, ranging from 0.1 years to ≥12 years\(^12\). The functional age of each patient was regarded as the developmental age corresponding to the item for which the highest-level responses were provided (“usually do”). FAB and ADL/IADL-COG ver.2.0 assessments were performed within 1–2 weeks of one another for each participant. FAB assessments were conducted in a quiet room by full-time occupational therapists at each facility. ADL/IADL-COG ver.2.0 assessments were also performed by full-time occupational therapists at each facility, who observed participant behavior or obtained relevant information from family members/caregivers.

Mean (± standard deviation, SD) FAB scores and functional age were calculated using descriptive analyses. Spearman’s rank correlation coefficients were used to determine the association between FAB score and functional age. Single regression analysis was performed to further examine the relationship between FAB score and functional age. The regression equation was then used to determine functional age based on FAB score. The threshold for significance was set at \(p<0.05\). All statistical analyses were performed using IBM SPSS version 22.0 (Tokyo, Japan).

**RESULTS**

Mean FAB score and functional age among all participants were 9.1 ± 4.9 points and 6.3 ± 3.4 years, respectively. Further analysis revealed a significant correlation between FAB score and functional age (\(r=0.80\); \(p<0.001\)). Single regression analysis revealed that the regression coefficient could be expressed in terms of the following linear regression equations (\(p<0.001\): functional age (years)\(=0.56 \times \)FAB score + 1.19; FAB score\(=1.15 \times \)functional age (years) + 1.86. The coefficient of determination (\(R^2\)) was 0.64, indicative of high predictive accuracy. Predicted functional ages based on FAB score are shown in Table 2.

**DISCUSSION**

The aim of the study states that the association of FAB scores and ADL/IADLs ability was also determined. The present study investigated the association between FAB scores and functional age among older adults. We observed a significant correlation between FAB score and functional age, which could be expressed via a linear regression equation.

The strength of a correlation coefficient can be defined as follows: 0.00–0.30, weak; 0.31–0.50, moderate; 0.51–0.80, strong; 0.81–1.00: very strong\(^13\). In the present study, the correlation coefficient between FAB score and functional age was equal to 0.80, indicative of a strong correlation. This finding is in accordance with the results of previous studies, which have reported strong correlations between scores on cognitive function assessments and functional age\(^8\)\(^{-10}\). Our findings support the notion that decreases in ADL/IADL ability among older adults are associated with decreases in cognitive function occurring in the reverse order of child development. In addition, the present study is the first to demonstrate a correlation between FAB scores and functional age.
$R^2$ represents the goodness-of-fit or predictive accuracy of a regression equation. Values closer to 1 are indicative of higher predictive accuracy, and $R^2=0.5$ is considered desirable\(^\text{14)}\). In the present study, $R^2$ was equal to 0.64, indicative of high predictive accuracy. Thus, FAB scores could be used to predict functional age, and vice versa. Recent cross-sectional studies have also reported that functional age can be predicted based on HDS-R, NM scale, and MMSE scores\(^\text{8–10)}\). However, the present study is the first to suggest that functional age can be predicted based on FAB scores.

The FAB is often used to assess cognitive function in clinical practice. Our results suggest that the regression equation and predicted values calculated in the present study can also be used in routine clinical practice. For example, a patient with

| Table 1. Characteristics of study participants (n=85) |
|-----------------------------------------------|
| Gender, n(%)                             |
| Male                                    23 (27.1) |
| Female                                  62 (72.9) |
| Age (years), mean (SD)                   83.5 (7.3) |
| Classifications of housing, n(%)         |
| Home                                    42 (49.4) |
| Nursing home                            43 (50.6) |
| Type of long-term care required, n(%)    |
| Support required 1                       7 (8.2) |
| Support required 2                       10 (11.8) |
| Care level 1                             18 (21.2) |
| Care level 2                             20 (23.5) |
| Care level 3                             18 (21.2) |
| Care level 4                             10 (11.8) |
| Care level 5                             2 (2.4) |
| Degree of independent living for the disabled, n(%) |
| Rank J 1                                 7 (8.2) |
| Rank J 2                                 15 (17.7) |
| Rank A 1                                 13 (15.3) |
| Rank A 2                                 14 (16.5) |
| Rank B 1                                 20 (23.5) |
| Rank B 2                                 12 (14.1) |
| Rank C 1                                 2 (2.4) |
| Rank C 2                                 2 (2.4) |
| Degree of independent living for the elderly, n(%) |
| Normal                                  12 (14.1) |
| Rank I                                  28 (32.9) |
| Rank IIa                                15 (17.7) |
| Rank IIb                                20 (23.5) |
| Rank IIIa                               6 (7.1) |
| Rank IIIb                               3 (3.5) |
| Rank IV                                 1 (1.2) |
| Major diseases, n                       |
| Cerebrovascular disorder                36 |
| Alzheimer-type dementia                 21 |
| Osteoarthritis                          19 |
| Fracture                                17 |
| Vascular dementia                       10 |
| Heart disease                           6 |
| Parkinson's disease                     5 |
| Lumbar spinal canal stenosis            4 |
| Depression                              4 |
| Disuse syndrom                          2 |

| Table 2. Predicted value of functional age corresponding to FAB score |
|--------------------------|--------------------------|
| FAB (score) →           | Predicted value of functional age (year) |
| 0                       | 1.2                       |
| 1                       | 1.8                       |
| 2                       | 2.3                       |
| 3                       | 2.9                       |
| 4                       | 3.4                       |
| 5                       | 4.0                       |
| 6                       | 4.6                       |
| 7                       | 5.1                       |
| 8                       | 5.7                       |
| 9                       | 6.2                       |
| 10                      | 6.8                       |
| 11                      | 7.4                       |
| 12                      | 7.9                       |
| 13                      | 8.5                       |
| 14                      | 9.0                       |
| 15                      | 9.6                       |
| 16                      | 10.2                      |
| 17                      | 10.7                      |
| 18                      | 11.3                      |
an FAB score of 5 points is considered to exhibit a functional age of 4 years, based on the regression equation. In this case, if the ADL/IADL ability of the patient as assessed via laboratory observation is, in fact, equivalent to the developmental stage of a four-year-old, the patient may be considered to exhibit ADL/IADL abilities corresponding to his/her level of cognitive function. In this way, the patient’s predicted functional age can be used to determine the relationship between cognitive function and ADL/IADL ability, set concrete goals regarding ADL/IADLs, and clarify the targets of intervention (psychological issues, motor-sensory function, human/physical environment, etc.).

The present study is limited by its small sample size. Thus, the study results may not be fully generalizable to other regions and countries. In addition, analysis based on the presence or absence of dementia could not be performed. Further studies involving larger sample sizes are required.

In the present study, we examined the association between FAB scores and ADL/IADLs ability based on child development in older adults. Our findings indicated that there was a significant association between FAB scores and functional age as determined using the ADL/IADL-COG ver.2.0. Furthermore, we observed that FAB scores could be used to predict functional age. Such knowledge may aid occupational therapists in determining the relationship between cognitive function and ADL/IADLs ability, setting goals regarding ADL/IADLs, and determining intervention targets in older adults.

Conflict of interest

None.

ACKNOWLEDGEMENTS

The author thanks all participants and collaborators for their involvement in this study. We would like to thank Editage (www.editage.jp) for English language editing.

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