The use of short versions of the Japanese WAIS–III to aid in differentiation between Alzheimer's disease and dementia with Lewy bodies

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Abstract

Objective: We examined the cognitive characteristics of patients with Alzheimer's disease (AD) and dementia with Lewy bodies (DLB) using the Wechsler Adult Intelligent Scale-Third Edition (WAIS-III). In addition, the utility of short versions of WAIS-III for estimating IQ scores and index scores were examined.

Methods: The subjects were 83 patients with probable AD, 33 patients with probable DLB, and 83 cognitively normal individuals.

Results: Patients with DLB showed significantly lower scores in Performance IQ and Processing Speed compared with those with AD. The short versions of WAIS-III with Information, Similarities, Arithmetic, Digit Span, Picture Completion, Digit Symbol-Coding, and Block Design demonstrated relatively small amount of error, high correlations and reliabilities with the full version.

Conclusions: The results indicated that Performance IQ and Processing Speed in WAIS-III can be an indicator for differentiating AD and DLB in WAIS-III, and a short version obtained by the Similarities, Information, Picture Completion, Block Design, Arithmetic, Digit Span, and Digit-Symbol Coding yields high accuracy and can be used to estimate full-scale IQ scores on the WAIS-III.

Keywords: Alzheimer's disease, dementia with Lewy bodies, assessment, Elderly/Geriatrics/Aging

Introduction

Dementia with Lewy bodies (DLB) is the second most common form of degenerative dementia after Alzheimer's disease (AD) (Vann Jones & O'Brien, 2014; Kemp et al. 2017). Patients with DLB exhibit gradual memory decline, cognitive fluctuations, visual hallucinations (VH), and parkinsonism (McKeith et al. 2005). In neuropsychological examinations, patients with DLB tend to perform poorly compared with those with AD in tests that measure visuoperception and visual attention, such as Pentagon Copying, Overlapping Figures, Bender Gestalt Test, and Illusory Contours (Ala, Hughes, Kyrouac, Ghobrial, & Elble, 2001; Mori et al. 2000; Murayama, Iseki, Yamamoto, Kimura, Eto, &Arai, 2007; Ota et al. 2015). In the Wechsler Adult Intelligent Scale-Revised (WAIS-R), patients with DLB are likely to obtain significantly lower scores in Performance IQ compared with patients with AD (Oda, Yamamoto, & Maeda, 2009; Shimomura, Mori, Yamashita, Imamura, Hirono, & Hashimoto, 1998). However, there have been no studies examining differences between AD and DLB using WAIS-III, which is the latest version of the WAIS that is available for use in Japan. Compared with the previous version (WAIS-R), the WAIS-III has extended utility for use with geriatric individuals, as the normative data was extended to include individuals up to 89 years old. The detailed neuropsychological examinations such as WAIS-III play an important role in the early detection of cognitive decline or dementia, especially when assessing mild cognitive impairment (MCI) or the early stage of dementia (Izawa et al. 2009).

The use of the WAIS-III in geriatric individuals can be accompanied by some challenges, such as fatigue and frustration owing to the length of time required for administration (Donnell, Pliskin, Holdnack, Axelrod, & Randolph, 2007). For these reasons, short versions of the WAIS may be especially useful for examining geriatric individuals. The short versions of the WAIS have been examined extensively in people of various age groups and medical backgrounds. For example, Ryan & Ward (1999) examined validity and reliability of seven-subtest short versions of WAIS-III for 13 age groups in the standardization sample of WAIS-III. They found that the seven-subtest short versions of the WAIS-III were highly reliable for estimating Verbal IQ (VIQ), Performance IQ (PIQ), and Full scale IQ (FSIQ) scores in older age groups (65 years of age and older) as well as in other age groups (16 to 64 years of age). The seven subtests included in the short version were Information, Similarities, Arithmetic, Digit Span, Picture Completion, Digit Symbol-Coding, and Matrix Reasoning or Block Design. The first four subtests are used to estimate VIQ score, and the last three are used to estimate PIQ score. In addition, Brooks & Weaver (2005) examined the accuracy of eight short versions of the WAIS-III, which were all designed to estimate VIQ, PIQ, and FSIQ scores in geriatric individuals with suspected memory decline or cognitive impairment. They also found that the short versions including the same seven subtests (Information, Similarities, Arithmetic, Digit Span, Picture Completion, Digit Symbol-Coding, and Matrix Reasoning or Block Design) were the most accurate in their sample. In both of these studies, the short versions with either Matrix Reasoning or Block Design had nearly equal utility (Ryan & Ward, 1999; Axelrod, Ryan & Ward, 2001; Brooks & Weaver, 2005). Brooks and Weaver (2006) also examined the utility of short versions of the WAIS-III in estimating four index scores (Verbal Comprehension: VC, Perceptual Organization: PO, Working Memory: WM, and Processing Speed: PS) in the WAIS-III, with the same clinical samples as in their previous study (Brooks & Weaver, 2005). They reported that, in a clinical setting, the short versions including two subtests exhibited better accuracy for predicting VC, PO, and WM scores than short versions with only one subtest, and for PS scores, both the Digit Symbol-Coding and Symbol Search alone could accurately estimate PS score of the full version (Brooks & Weaver, 2006). The administration time for the full version WAIS-III with 13 subtests is 80 minutes on average, ranging from 65 to 90 minutes (Japanese WAIS-III Publication Committee, 2006), while the short version with seven subtests takes approximately 50 minutes (Fujita, Maekawa, Dairoku, & Yamanaka, 2011).

Previous studies of the short version WAIS-III in geriatric individuals have included patients with AD, Huntington's disease, and Parkinson's disease, as well as individuals with suspected dementia or general cognitive impairment (Donnell, Pliskin, Holdnack, Axelrod, & Randolph, 2007; Brooks & Weaver, 2005; Randolph, Mohr, & Chase, 1993). To the best of our knowledge, no studies have examined the utility of short versions of the WAIS-III specifically for examining patients with DLB. In the present study, we compared the cognitive characteristics of AD and DLB using the WAIS-III. In addition, we also explored the validity of four short versions of the WAIS-III in estimating VIQ, PIQ, and FSIQ scores, six short versions in estimating VC, PO, and WM scores, and two short versions in estimating PS scores in patients with AD and DLB, because short versions of the WAIS-III tend to be used for geriatric individuals.

Methods

Subjects

Subjects were recruited from the memory clinic at Juntendo Tokyo Koto Geriatric Medical Center in Japan from 2008 to 2012. The subjects for this study were aged between 52 and 89 years and had received a clinical diagnosis of probable AD based on the diagnostic criteria of the National Institute on Aging and the Alzheimer's Association workgroup (NIA-AA) (McKhann et al. 2011), a diagnosis of probable DLB based on the criteria adopted at the third International Workshop on DLB (McKeith et al. 2005), or cognitively normal individuals which showed a MMSE score of 28 and higher, no complaints of memory decline, and no deficits observed as a result of neuroimaging. Consequently, we identified 99 probable AD patients, 37 probable DLB patients, and 86 cognitively normal individuals. After controlling for age and years of education between probable AD patients, probable DLB patients, and cognitively normal individuals, and controlling for MMSE scores between probable AD and probable DLB patients, we selected 83 probable AD patients (AD group), 33 probable DLB patients (DLB group), and 83 cognitively normal individuals (Normal group).

For the detection of cognitive abilities, the Mini-Mental State Examination (MMSE), the full version of the WAIS-III, and the Wechsler Memory Scale –Revised (WMS-R) are used in our memory clinic. In order to aid the diagnosis of dementia, we evaluate the cognitive characteristics of AD and DLB, which are reported in the previous studies. For example, AD tends to exhibit impaired abstract thinking and verbal problem-solving abilities in WAIS-III whereas Perceptual organization is relatively preserved (Izawa et al. 2009), and DLB is likely to perform poorly in PIQ and pentagon copying in MMSE (Ala, Hughes, Kyrouac, Ghobrial, & Elble, 2001; Oda, Yamamoto, &Maeda, 2009). In addition, we examine memory decline by comparing the scores of WAIS-III and WMS-R.

The subjects also underwent neuroimaging examinations. We visually assessed the brain magnetic resonance imaging (MRI) (1.5 T scanner, MAGNETOM Symphony; Siemens, Munich, Germany) for brain atrophy and vascular changes. We found normal to mild atrophy for all the subjects, including in the medial temporal lobe, and vascular change typical for their age. The [^{18}F]-fluorodeoxyglucose (FDG) positron emission tomography (PET) was also performed in all the patients using a Discovery STEP scanner (GE Health-care, Chalfont St Giles, UK). The procedure for the [^{18}F]-FDG PET was based on previously described methods (Iseki et al., 2010; Fujishiro et al., 2010). To evaluate the regional cerebral metabolic rate of glucose (CMRglc) reduction in all the patients, we used three-dimensional stereotactic surface projection (3D-SSP) analysis to compare the CMRglc for each patient with that of a group of age-matched control individuals from a normative database (Iseki et al., 2010). Significant glucose hypometabolism in the temporoparietal/precuneus on [^{18}F]-FDG PET is considered to support a diagnosis of AD (McKhann et al., 2011) whereas significant occipital hypometabolism is regarded as a clinical marker for DLB (McKeith et al. 2005).

Figure shows the diagnosis procedure in our memory clinic.

The demographics and scores of MMSE and WMS-R are listed in Table 1. ANOVA and Tukey's post-hoc test were performed for the mean age, years of education, MMSE scores, and the scores of WMS-R.

Procedures

The short versions of WAIS-III that were investigated in the present study was adopted form the 7-subest short version of WAIS-R proposed by Ward (1990). The Ward's short version of WAIS-R consists of Information, Similarities, Arithmetic, Digit Span, Picture Completion, Digit Symbol-Coding, and Block Design, and can decrease the administration time by approximately 50% (Ward, 1990). Although this abbreviated version was originally developed with WAIS-R, it can also be used with WAIS-III. The short versions of WAIS-R and WAIS-III using Ward's seven subtests have been reported to be very highly correlated with the original scores and the estimated scores are not significantly different from the original scores (Pilgrim et al. 1999, Ryan & Ward, 1999; Axelrod, Ryan & Ward, 2001). In addition, Ward's short version of WAIS-III provides equivalent accuracy when Block Design is substituted with Matrix Reasoning (Axelrod, Ryan & Ward, 2001). The present study investigated four short versions using Ward's seven subtests with either Block Design or Matrix Reasoning. SV1 is based on Paolo and Ryan (1993) and SV2 substituted Block Design with Matrix Reasoning. SV3 was derived from Ward (1990) and SV4 substituted Block Design with Matrix Reasoning. We chose to investigate these methods because they were reported to be highly correlated with the original WAIS-III in geriatric populations (Brooks and Weaver, 2005). Scoring methods for IQ scores for each short version (SV1, SV2, SV3, SV4) are listed in Table 2.

For the full version of the WAIS-III, we obtained three IQ (VIQ, PIQ, and FSIQ) scores and four index (VC, PO, WM, and PS) scores via the standard procedure described in the administration and scoring manual for the WAIS-III (Japanese WAIS-III Publication Committee, 2006). IQ (VIQ-S, PIQ-S, and FSIQ-S) and index (VC-S, PO-S, WM-S, and PS-S) scores on the short versions of the WAIS-III were obtained by re-scoring the original WAIS-III protocol. Based on previous studies (Brooks & Weaver, 2005; Brooks and Weaver, 2006), we evaluated clinical accuracy by calculating the percentage of short version scores that fell within ± 2 standard errors of measurement (2SEM). We calculated the 2SEM for each IQ score as the average SEM for the age group above 55 years old in the standardization sample, as described in the technical manual for the WAIS-III (Japanese WAIS-III Publication Committee, 2006). Consequently, the 2SEM values for VIQ, PIQ, and FSIQ scores were 5.34, 5.92, and 3.96, respectively, and the 2SEM values for VC, PO, WM, and PS scores were 5.80, 7.89, 8.09, and 7.72, respectively, in the present study. We also examined the reliability of the IQ and index scores in the short versions using Cronbach's alpha (α). The correlations between the full and short versions of the WAIS-III were examined using Pearson's Correlation analysis (*r*). The effect sizes of the full and short versions of IQ and index scores were also calculated.

To examine the cognitive characteristics of AD and DLB, we compared the average full and short versions of IQ and index scores respectively among the three groups using an ANOVA and Tukey's post-hoc test. We also undertook logistic regression analysis to examine the validity of the results. We used the diagnosis (AD or DLB) as dependent variable and the 14 subtest scores in WAIS-III as predictors.

Written informed consent was obtained from all the subjects. The present study was approved by the Ethics Committee of Juntendo Tokyo Koto Geriatric Medical Center.

Results

Tables 3 and 4 present the average IQ and index scores for the full and short versions, the percentages of short version scores that fell within ± 2SEM, the correlations between the IQ and index scores obtained from the full and short versions, the reliabilities of the IQ and index scores from the short versions, effect sizes, and the results of the ANOVA and Tukey's post-hoc test (only the *p* values for comparisons between AD and DLB groups are shown). Table 4 shows the scoring methods for the index scores in the short versions of the WAIS-III.

IQ scores

All of the short versions had high correlations and reliabilities for all groups. For VIQ-S, the percentages of VIQ-S scores that fell within ±2SEM of the VIQ score ranged from 75.9 to 88.0, and SV1 and SV2 demonstrated higher percentages than SV3 and SV4. For PIQ-S, the percentages of PIQ-S scores that fell within ± 2SEM of the PIQ score ranged from 63.6 to 90.9, and SV3 had the highest average percentage across the three groups. For FSIQ-S, the percentages of FSIQ-S scores that fell within ± 2SEM of the FSIQ scores ranged from 61.4 to 83.1, and SV3 showed the highest average percentage across the three groups.

The average percentages of short version scores that fell within ± 2SEM of each full versions including all the groups and all three IQ scores were 80.1 for SV1, 77.6 for SV2, 81.2 for SV3, and 72.4 for SV4.

The comparison of average full version IQ scores among the three groups using ANOVA and Tukey's post-hoc test indicated that the Normal group obtained significantly higher scores than the AD and DLB groups for all IQ scores. Between the AD and DLB groups, we found no significant difference in VIQ and FSIQ scores, but the AD group obtained significantly higher

PIQ scores compared with the DLB group. The subjects obtained comparable IQ scores on the SV1, SV2, SV3 and the full version of the WAIS-III, but we found no significant differences between the AD and DLB groups in terms of PIQ-S scores on SV4.

Index scores

For VC-S, the percentages of the VC-S scores that fell within ± 2SEM of the VC score ranged from 42.4 to 95.2, and the short version that included <Similarity and Information> had relatively high percentages. For PO-S, the percentages of the PO-S scores that fell within ± 2SEM of the PO score ranged from 45.8 to 97.0, and the short version that included <Picture Completion and Block Design> had the highest percentages for all groups. For WM-S, the percentages of the WM-S scores that fell within ± 2SEM of the WM score ranged from 18.1 to 90.9, and the short versions that included <Digit Span and Letter-Number Sequence> had the highest average percentages among the three groups. For PS-S, the two short versions were comparable in terms of accuracy, correlations and reliability for all the groups.

When we compared the average full version index scores among the three groups using ANOVA and Tukey's post-hoc test, it was found that the Normal group obtained significantly higher scores than the AD and DLB groups for all index scores. Between the AD and DLB groups, we found no significant differences in VC, PO, or WM scores, although the PS score was significantly lower in the DLB group compared with the AD group. The average VC-S, PO-S, and WM-S scores were comparable with the full version scores. For the PS-S, the results were comparable with the full version scores for the short version with Digit Symbol Coding only, and we found no significant difference between the AD and DLB groups for the short version with Symbol Search.

Logistic regression analysis

The dependent variable was diagnosis (AD or DLB) and the independent variables were the 14 subtest scores in WAIS-III. Nagelkerke's R2 was 0.17 and the overall classification accuracy was 71.6％. The results indicated that Similarity was a predictor for AD (Wald Statistic: 6.41, odds ratio: 1.30, 95%CI: 1.06-1.59, $p<0.01$) and Digit Symbol Coding was a predictor for DLB (Wald Statistic: 11.74, odds ratio: 0.73, 95%CI: 0.61-0.87, $p<0.01$)

Discussion

In the present study, we examined the cognitive characteristics of AD and DLB using the WAIS-III, and the utility of four short versions of the WAIS-III in estimating VIQ, PIQ, and FSIQ scores, six short versions in estimating VC, PO, and WM scores, and two short versions in estimating PS scores in AD, DLB patients, and cognitively normal individuals.

We found that in the full-version WAIS-III, PIQ and PS scores were significantly lower in the DLB group compared with the AD group, suggesting that these scores can be an indicator for differentiating AD and DLB in the WAIS-III. In addition, despite the non-significant level, PO scores was poorer in the DLB group than in the AD group, reflecting the cognitive characteristics of DLB, that is, DLB tends to exhibit deficits in visuoperception and visual attention (Ala, Hughes, Kyrouac, Ghobrial, & Elble, 2001; Mori et al. 2000; Murayama, Iseki, Yamamoto, Kimura, Eto, &Arai, 2007; Ota et al. 2015). The logistic regression analysis also indicated that Digit-Symbol Coding and Similarity are the most appropriate for discriminating DLB and AD respectively. These results add the validity of the present study that DLB tends to score lower than AD in performance subtest.

For the utility of the short versions, the present study indicated that SV1, SV2, and SV3 produced significantly lower PIQ-S scores in the DLB group compared with the AD group. This result was comparable with that produced by the full version, suggesting that these short versions have potential for differentiating DLB from AD. In terms of the accuracy of the short version (the average percentages of short version scores that fell within ± 2SEM of the full version scores), SV3 showed the highest accuracy, indicating that SV3 may be the most useful in estimating IQ scores in AD, DLB patients, and cognitively normal individuals.

For index scores, the short versions that exhibited the highest accuracy were those that contained <Similarities and Information> for the VC-S, <Picture Completion and Block Design> for the PO-S, and <Digit Span and Letter-Number Sequencing> for the WM-S. For the PS-S, although Digit-Symbol Coding and Symbol Search were nearly equivalent in terms of accuracy, correlation, and reliability, ANOVA and Tukey's post-hoc test indicated that only the short version with Digit-Symbol Coding could differentiate AD from DLB. These results indicate that, if only index scores need to be estimated, the above subtests can be efficient. However, in most clinical settings using WAIS-III, the estimation of IQ scores are required in addition to index scores. Letter-Number Sequencing is used only for the index scores, therefore the use of Letter-Number Sequencing is not practical when both IQ scores and index scores need to be assessed. Instead, the combination of <Arithmetic and Digit Span>, which showed almost equal accuracy with <Digit Span and Letter-Number Sequencing>, can be more efficient for estimating both IQ and index scores. Based on these results, for the estimation of IQ and index scores, it appears that SV3, which contained the Similarities, Information, Picture Completion, Block Design, Arithmetic, Digit Span, and Digit-Symbol Coding, is useful in AD and DLB patients as well as cognitively normal individuals, and have potential for differentiating between DLB and AD.

The previous studies showed that the short versions with either Matrix Reasoning or Block Design had nearly equal utility (Ryan & Ward, 1999; Brooks & Weaver, 2005). We found, however, that Block Design produced a more accurate estimate of PIQ scores compared with Matrix Reasoning. An explanation for this result can be that the Block Design is timed while Matrix Reasoning is not. The DLB group obtained significantly lower PS scores than the AD group, indicating that poorer motor function and speed in DLB affected the results of the Block

Design. In addition, Block Design primarily measures Perceptual organization/visual processing but Matrix Reasoning primarily measures Fluid reasoning/fluid intelligence (Weiss, Keith, Zhu, & Chen, 2013). Therefore, compared with Matrix Reasoning, Block Design may be more likely to reflect the cognitive characteristics of DLB, and thus may be more useful in detecting DLB.

The main limitation of the present study is that the degree of cognitive dysfunction in our AD and DLB patients was mostly mild and very mild, and our patients obtained relatively high WAIS-III scores. The accuracy of the short versions of the WAIS-III may be lower when the scores are in a low range, and the calculation formula may need to be adjusted accordingly (Fujita, Maekawa, Dairoku, & Yamanaka, 2011). Therefore, further studies are needed to examine whether the seven-subtest short versions of the WAIS-III are useful for assessing AD and DLB patients with lower IQ and index scores.

In conclusion, we examined the cognitive characteristics of AD and DLB patients using the WAIS-III, and the accuracy of short versions of the WAIS-III for estimating IQ and index scores in AD and DLB patients. We found that DLB tends to perform significantly more poorly than AD in PIQ and PS. Another finding in the present study is that the short versions with the Information, Similarities, Arithmetic, Digit Span, Picture Completion, Digit Symbol-Coding, and Block Design produced accurate estimations of IQ scores and index scores, indicating that these tests have potential for detecting the cognitive characteristics of AD and DLB.

Disclosure Statement

The authors disclose no conflict of interest.

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Table 1 Subjects' demographic information and scores of MMSE and WMS-R

	AD (n=83)	DLB (n=33)	Normal (n=83)
mean age (SD)	73.2 (8.8)	74.6 (6.0)	71.3 (5.5)
male : female	32:51	19:14	27:56
years of education (SD)	12.0 (2.3)	12.8 (2.6)	13.2 (2.4)
MMSE score (SD)	21.3* (3.1)	22.2* (3.4)	28.2 (1.9)
Pentagon correct (%)	85.4	59.4	100.0
WMS-R			
Verbal Memory	74.8* (11.9)	81.9* ** (10.4)	106.1 (13.0)
Visual Memory	68.2* (13.7)	69.7* (14.2)	108.2 (12.5)
General Memory	69.6* (10.9)	75.5* ** (10.3)	107.6 (12.3)
Attention	93.6* (13.7)	92.6* (12.4)	110.8 (13.0)
Delayed Recall	59.4* (9.5)	71.1* ** (12.0)	104.9 (12.3)

* : Significantly lower than Normal (p<.05); ** : Significantly lower than AD (p<.05)

Table 2 Scoring methods for each short version of WAIS-III

	VIQ	PIQ	FSIQ
SV 1	① 1.5 (I+S+A+DS)	② 1.67 (PC+DC+BD)	①+②
SV 2	① 1.5 (I+S+A+DS)	② 1.67 (PC+DC+MR)	①+②
SV 3	① 2 (I+S)+A+DS	② 2 (PC+BD) +DC	①+②
SV 4	① 2 (I+S)+A+DS	② 2 (PC+MR) +DC	①+②

S: Similarities; A: Arithmetic; DS: Digit Span; I: Information; PC: Picture Completion; DC: Digit-Symbol Coding; BD: Block Design; MR: Matrix Reasoning; SS: Symbol Search; LS: Letter-Number Sequencing; "1.5(I+S+A+DS)" means that the sum of the scores for Information, Similarities, Arithmetic and Digit Span was multiplied by 1.5 and was prorated according to the scoring table for VIQ in WAIS-III manual; FSIQ score is calculated by summing the prorated VIQ and PIQ scores and prorated according to the scoring table in WAIS-III manual.

Table 3 Mean IQ scores and comparison of full version and short versions for AD, DLB and Normal groups

	AD		DLB		Normal					
	Mean (SD)	2SME%	Mean (SD)	2SME%	Mean (SD)	2SME%	α	*r*	effect size	*p*
VIQ										
Full	96.7* (12.8)	–	98.1* (12.3)	–	113.4 (9.4)	–	–	–	0.11	0.82
SV 1	95.9* (13.1)	88.0	97.7* (11.6)	87.9	112.0 (9.4)	83.1	0.93	0.97	0.10	0.73
SV2	95.9* (13.1)	88.0	97.7* (11.6)	87.9	112.0 (9.4)	83.1	0.93	0.96	0.10	0.73
SV3	95.1* (12.7)	86.7	96.8* (12.0)	84.8	110.9 (9.7)	75.9	0.93	0.97	0.10	0.75
SV4	95.1* (12.7)	86.7	96.8* (12.0)	84.8	110.9 (9.7)	75.9	0.93	0.96	0.10	0.75
PIQ										
Full	86.6* (16.3)	–	79.5* ** (13.9)	–	108.6 (11.3)	–	–	–	0.19	**0.04**
SV 1	86.3* (16.1)	81.9	78.4* ** (15.0)	90.9	108.5 (11.7)	71.1	0.90	0.98	0.19	**0.02**
SV2	88.6* (15.9)	72.3	81.4* ** (14.7)	72.7	108.8 (12.0)	77.1	0.91	0.97	0.15	**0.04**
SV3	86.2* (16.4)	84.3	78.6* ** (15.0)	90.9	108.2 (11.7)	77.1	0.90	0.98	0.18	**0.03**
SV4	88.9* (16.4)	68.7	82.3* (14.8)	63.6	108.5 (12.1)	72.3	0.91	0.96	0.13	0.07
FIQ										
Full	91.3* (14.9)	–	88.7* (13.1)	–	113.1 (11.8)	–	–	–	0.18	0.58
SV 1	90.6* (14.7)	80.7	86.7* (15.4)	75.8	111.5 (10.5)	61.4	0.95	0.98	0.17	0.32
SV2	91.8* (14.7)	68.7	89.2* (12.7)	72.7	111.7 (10.4)	75.9	0.96	0.98	0.16	0.57
SV3	90.2* (14.7)	72.3	87.4* (13.4)	75.8	110.7 (10.4)	83.1	0.95	0.98	0.17	0.54
SV4	91.6* (14.7)	71.1	89.2* (12.9)	66.7	111.4 (11.5)	61.4	0.96	0.98	0.14	0.64

The *p* values between AD and DLB groups were listed.

* : Significantly lower than Normal ($p<.05$); ** : Significantly lower than AD ($p<.05$)

Table 4 Mean Index scores and comparison of full version and short versions for AD, DLB and Normal groups

	AD		DLB		Normal					
	Mean (SD)	2SME%	Mean (SD)	2SME%	Mean (SD)	2SME%	α	*r*	effect size	*p*
VC										
Full	96.0* (11.2)	—	97.2* (11.8)	—	108.6 (0.87)	—	—	—	0.07	0.83
3×V	97.3* (13.5)	61.4	98.7* (13.6)	78.8	110.4 (11.2)	63.9	0.93	0.89	0.04	0.85
3×S	98.2* (14.4)	57.8	100.9* (14.2)	48.5	111.2 (10.5)	61.4	0.92	0.86	0.04	0.56
3×I	91.8* (12.7)	43.4	92.1* (15.0)	42.4	104.6 (12.7)	49.4	0.91	0.84	0.05	1.00
1.5×(V+S)	98.3* (12.5)	77.1	100.3* (11.9)	84.8	111.2 (9.4)	77.1	0.97	0.95	0.05	0.65
1.5×(V+I)	95.1* (11.7)	85.5	96.0* (12.9)	81.8	107.7 (0.95)	89.2	0.98	0.96	0.06	0.92
1.5×(S+I)	95.6* (11.3)	95.2	96.9* (12.3)	87.9	108.4 (9.7)	88.0	0.98	0.96	0.06	0.85
PO										
Full	87.9* (15.8)	—	82.1* (13.8)	—	106.5 (10.7)	—	—	—	0.13	0.09
3×PC	90.1* (18.7)	53.0	84.1* (18.2)	63.6	109.6 (14.1)	55.4	0.92	0.86	0.09	0.20
3×BD	83.8* (19.9)	45.8	77.1* (15.2)	63.6	104.8 (15.2)	48.2	0.92	0.86	0.10	0.15
3×MR	90.2* (17.7)	63.9	85.6* (13.9)	78.8	105.5 (13.6)	71.1	0.94	0.89	0.05	0.32
1.5×(PC+BD)	87.2* (16.5)	90.4	80.9* (14.9)	97.0	107.5 (11.4)	91.6	0.99	0.98	0.15	0.09
1.5×(PC+MR)	90.5* (26.3)	75.9	85.1* (14.8)	81.8	107.9 (11.9)	80.7	0.98	0.95	0.10	0.16
1.5×(BD+MR)	87.2* (17.1)	83.1	81.5* (13.6)	90.9	105.6 (12.0)	89.2	0.98	0.96	0.11	0.14
WM										
Full	92.3* (15.0)	—	93.0* (12.3)	—	109.4 (0.95)	—	—	—	0.10	0.96
3×A	85.5* (16.8)	54.2	88.1* (15.6)	63.6	103.9 (14.5)	45.8	0.83	0.83	0.06	0.71
3×DS	107.3* (18.1)	18.1	107.9* (15.5)	27.3	122.2 (15.3)	27.7	0.86	0.86	0.03	0.98
3×LN	83.5* (17.2)	51.8	83.1* (13.6)	45.5	103.5 (11.9)	51.8	0.86	0.88	0.10	0.99
1.5×(A+DS)	97.2* (15.5)	80.7	98.6* (12.2)	81.8	113.3 (11.3)	84.3	0.98	0.96	0.07	0.87
1.5×(A+LS)	85.1* (15.3)	59.0	86.1* (13.7)	63.6	104.2 (9.6)	80.7	0.98	0.96	0.12	0.93
1.5×(DS+LN)	96.0* (15.8)	83.1	95.9* (12.8)	90.9	113.2 (11.6)	83.1	0.97	0.95	0.08	1.00
PS										
Full	86.7* (15.4)	—	79.2* ** (15.8)	—	106.7 (10.4)	—	—	—	0.17	**0.02**
2×DC	89.9* (15.4)	78.3	80.6* ** (16.9)	81.8	108.2 (13.5)	78.3	0.97	0.95	0.12	**0.01**
2×SS	83.6* (17.2)	79.5	77.7* (16.2)	81.8	105.8 (11.2)	80.7	0.98	0.95	0.16	0.13

VC: Verbal Comprehension; PO: Perceptual Organization; WM: Working Memory; PS: Processing Speed; V: Vocabulary; S: Similarities; I: Information; PC: Picture Completion; BD: Block Design; MR: Matrix Reasoning; A: Arithmetic; DS: Digit Span; LN: Letter-Number Sequencing; DC: Digit-Symbol Coding; SS: Symbol Search; "3×V" means that the score for Vocabulary was multiplied by 3 and was prorated according to the scoring table in WAIS-III manual; "1.5(V+S)" means that the sum of the scores for Vocabulary and Similarities was multiplied by 1.5 and was prorated according to the scoring table in WAIS-III manual.

The *p* values between AD and DLB groups were listed.

* : Significantly lower than Normal ($p<.05$); ** : Significantly lower than AD ($p<.05$)

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