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Original Scientific Article

ASSESSMENT OF THE INSTRUMENTAL ACTIVITIES OF DAILY LIVING IN MILD COGNITIVE IMPAIRMENT AND DEMENTIA DUE TO ALZHEIMER'S DISEASE: DIAGNOSTIC ACCURACY OF THE SERBIAN VERSION OF THE AMSTERDAM IADL QUESTIONNAIRE

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Abstract. *To establish a diagnosis of dementia, it is necessary, in addition to cognitive impairment, to prove the existence of a disorder of instrumental activities of daily living (IADL). The Amsterdam IADL Questionnaire is a reliable instrument translated into different languages. This study aims to assess the diagnostic accuracy of the Serbian version of the Amsterdam IADL Questionnaire. The study included 75 patients with mild cognitive impairment (MCI) and dementia due to Alzheimer's disease. The questionnaire was scored using the weighted average (WA) and item response theory (IRT) scoring method. Diagnostic accuracy was examined using receiver–operating characteristic (ROC) curves. The area under the curves (AUC) was calculated with 95% confidence intervals (CI). The correlation between IRT and WA scores was strong and significant ($r=-0.980$, $p<0.001$). The AUC for the IRT scores of A-IADL-Q was 0.832 (95% CI: 0.729 to 0.909), while the AUC for the WA scores of A-IADL-Q was 0.848 (95% CI: 0.746 to 0.920). Both were significantly different from the AUC of 0.5 ($p<0.001$). There was no significant difference between the AUCs of IRT and WA scoring ($z=1.157$; $p=0.247$). Cutoffs and the highest combination of sensitivity and specificity for the IRT (sensitivity 0.767; specificity 0. 844) and WA (sensitivity 0.744; specificity 0. 844) scores of A-IADL-Q were calculated. We have shown that A-IADL-Q has moderate diagnostic accuracy in differentiating dementia and MCI. This instrument can be used in combination with cognitive measures to diagnose dementia in its early stages*.

Key words: *Alzheimer's disease, Dementia, instrumental activities of daily living, Mild cognitive impairment (MCI)*

Introduction

In order to establish a diagnosis of dementia, it is necessary, in addition to cognitive impairment, to prove the existence of a disorder of instrumental activities of daily living (IADL) [1,2]. IADLs are complex everyday activities (like managing finances, using devices, public transportation, etc.) that become disrupted in early dementia [3]. Different questionnaires have been used to detect impairment of IADL [4]. However, the Amsterdam IADL questionnaire® (A-IADL-Q) was developed with an aim to have appropriate psychometric characteristics in both its standard form (with 70 questions) [3,5] and short form (30 questions) [6]. A-IADL-Q has been translated into and adapted for 31 languages, including Serbian [7]. The Serbian version of the short form of A-IADL-Q is a reliable and valid measure of IADL in patients with dementia and mild cognitive impairment, as shown in our previous study [8]. A-IADL-Q was administered using the Qualtrics online platform. Informers (friends and family members of patients) answer questions about 30 different everyday activities.

This instrument has different scoring methods, including weighted average (WA) and item response theory (IRT) scoring. The WA scoring is a simpler method, where total scores are obtained directly from the Qualtrics online platform. The IRT scores have better distribution and absence of floor and ceiling effect. However, the IRT scores have to be calculated separately in a process that delays clinical diagnosis [6].

This study is an extension of our previously published research [8], where we performed a reliability analysis (by assessing internal consistency and reproducibility) and evaluated the construction validity of the Serbian version of A-IADL-Q. The present study aims to assess the diagnostic accuracy of the Serbian version of the Amsterdam IADL Questionnaire as a screening tool for dementia and to determine the cutoffs with the best combination of sensitivity and specificity.

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Materials and Methods

The study included 75 patients with cognitive impairment: 32 patients with MCI and 43 with dementia due to AD. All patients were recruited at the Outpatients Department of the Clinic of Neurology, University Clinical Center Niš.

The diagnoses of probable dementia due to AD and MCI were established using the appropriate National Institute of Aging and Alzheimer's Association (NIA-AA) criteria [1,9]. A neurologist examined all patients, performed cognitive screening (mini-mental state examination (MMSE) [10]), and referred them for further laboratory, neuroimaging, and neuropsychological testing. Patients with severe dementia (MMSE <10) and those with motor impairment were excluded from the study.

This study protocol was reviewed and approved by the Ethical Board of the University Clinical Center Niš, and the Ethical Committee of the Medical faculty University of Niš. All patients and/or caregivers provided written informed consent. All the work with human subjects has been conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

A-IADL-Q [6,8] was completed by informers (close friends or relatives) of patients using the Qualtrics online platform (www.qualtrics.com). The A-IADL-Q short form consists of 30 items, and each item has a 5-point scale response option. The questionnaire was scored using the weighted average (WA) and item response theory (IRT) scoring methods.

The WA scoring method is implemented in the online platform, where it is calculated by dividing the total IADL score by the number of items assessed (value between 0 and 4) and multiplying it by 25. The WA A-IADL-Q score ranges from 0 to 100, where a higher score represents a more pronounced IADL impairment.

Scoring based on Item Response Theory (IRT) takes into account the different "difficulty" of items of the A-IADL-Q. Impairment of more complex activities contributes more to the total score than impairment of simpler activities [11]. The total score has a normal distribution with a mean of 50, a standard deviation (SD) of 10, and ranges from about 20 to 80, with lower scores representing poorer performance [11]. IRT scoring is described in more detail elsewhere [6].

WA and IRT A-IADL-Q scores, years of education, and age were compared in patients with dementia and those with MCI using the independent t-test. Gender distribution was explored using the chi-squared test. The correlation between different scoring methods was analyzed by the Pearson correlation coefficient.

Diagnostic accuracy was examined using receiver–operating characteristic (ROC) curves created for both the WA and IRT A-IADL-Q scores. The minimal sample size for the area under the ROC curve analysis was estimated with a power of 80% and a significance level of 5% [12]. We have calculated the area under the curves (AUC) with 95% confidence intervals (CI). The AUCs were classified as having low (0.50 - 0.70), moderate (0.71 - 0.90), and high accuracy (>0.90) [13]. The best possible cutoff score with the highest combination of sensitivity and specificity was determined using the Youden index, calculated by deducting 1.0 from the sum of sensitivity and specificity [14]. AUCs of different ROC curves were compared using the DeLong method [15].

Results

Demographic parameters are presented in Table 1. There was no statistically significant difference in gender distribution between the two diagnostic groups ($\chi^2 = 0.12$, p=0.914). MCI group had a higher level of education (χ^2=7.137; p=0.028) and longer average education in years than the dementia group (t=3.208; p=0.002). The dementia group was significantly older than the MCI group (t=-2.615; p=0.011).

Table 1 Demographic parameters and Mini-mental state examination (MMSE) score of the patients with AD dementia and mild cognitive impairment (MCI)

	AD Dementia (N=43)	MCI (N=32)	Total (N=75)
Gender N (%)			
Female	25 (58.1%)	19 (59.4 %)	44 (58.7%)
Male	18 (41.9%)	13 (40.6%)	31 (41.3%)
Age (years) (M±SD)	76.58±7.02	70.81±11.98	74.12±9.81
MMSE	14.81±3.11	22.34±2.36	18.03±4.68
Education			
Primary level	24 (55.8%)	8 (25.0%)	32 (42.7%)
Secondary level	9 (20.9%)	11 (34.4%)	20 (26.7%)
Tertiary level	10 (23.3%)	13 (40.6%)	23 (30.6%)
Years of education (M±SD)	9.14±4.91	12.53±3.95	10.59±4.80

There was a statistically significant difference in MMSE scores between the two groups (t=11.445; p<0.001). A statistically significant difference was registered regarding both the WA (t=-6.059; p<0.001) and the IRT A-IADL-Q scores (t=5.670; p<0.001).

The AUC for the IRT scores of A-IADL-Q was 0.832 (95% CI: 0.729 to 0.909), which is significantly different from the AUC of 0.5 (z=7.236; p<0.001). The calculated AUC for the IRT scores showed moderate accuracy according to the Swets criteria.

The AUC for the WA scores of A-IADL-Q was 0.848 (95% CI: 0.746 to 0.920). It was significantly different from the AUC of 0.5 (z=7.948; p<0.001), reflecting moderate accuracy according to Swets criteria.

The difference between AUCs of IRT and WA scoring was 0.015 (95% CI: -0.011 to 0.041), which is not statistically significant (z=1.157; p=0.247) according to the DeLong method (shown in Fig. 1).

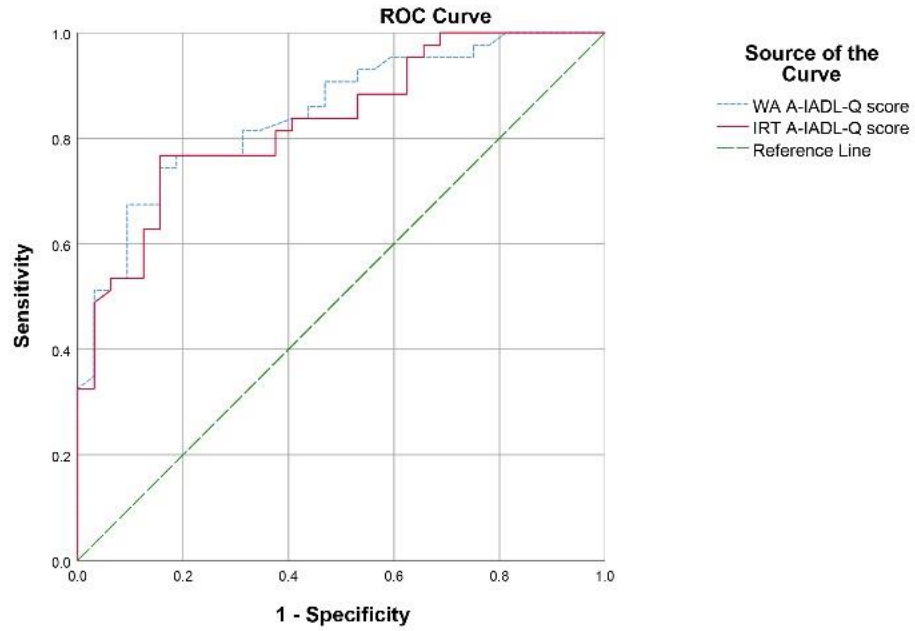

Fig. 1 Receiver–operating characteristic (ROC) curves created for the weighted average (WA) and item response theory (IRT) Amsterdam-IADL-Questionnaire (A-IADL-Q) scores

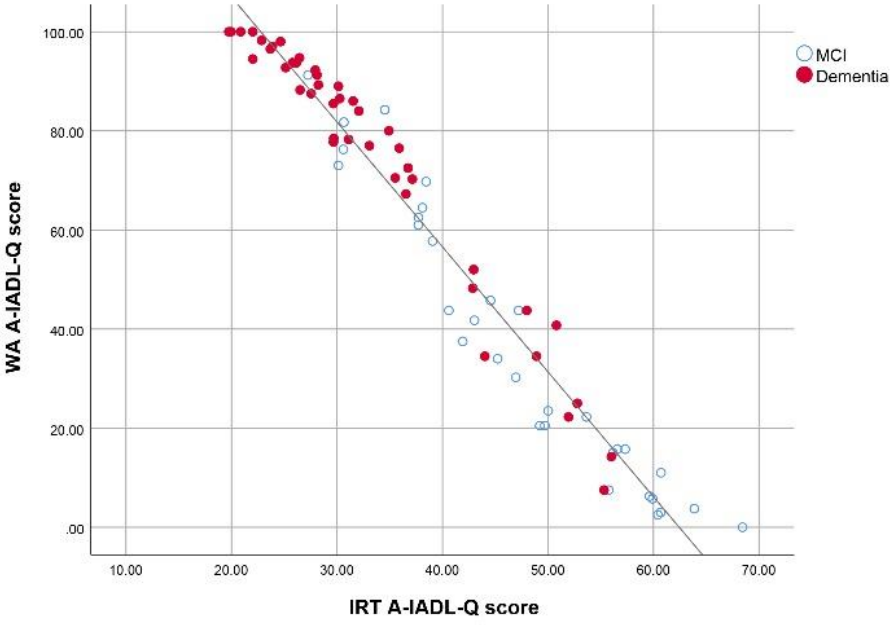

Fig. 2 Correlation (scatter plot) of the weighted average (WA) and item response theory (IRT) Amsterdam-IADL-Questionnaire (A-IADL-Q) scores in patients with dementia and mild cognitive impairment (MCI)

We have calculated the sensitivity and specificity values for the IRT and WA scores of the A-IADL-Q for different cutoff scores. The WA cutoff score of 69.75 points (Younden index = 0.588) had the highest combination of sensitivity 0.744 (95% CI: 0.588 – 0.865) and specificity 0. 844 (95% CI: 0.672 – 0.947). For the IRT scores, the highest combination of sensitivity (0.767 (95% CI: 0.614 – 0.882)) and specificity (0.844 (95% CI: 0.672 – 0.947)) was registered at the cutoff score of 37.146 (Younden index = 0.611).

The correlation between IRT and WA scores was strong and highly significant (r=-0.980, p<0.001) (shown in Fig. 2).

Discussion

Our study explored the diagnostic accuracy of two different scoring methods of A-IADL-Q in discriminating between dementia and MCI. Using both scoring methods, we have shown moderate diagnostic accuracy. It should be kept in mind that this questionnaire was not designed as an independent diagnostic tool for diagnosing dementia. However, in earlier studies, a diagnostic utility of the original version of A-IADL-Q was explored, and the cutoff score of 51.4 (using the IRT scoring method) with the best combination of sensitivity and specificity was calculated [16].

Our study showed a significantly lower cutoff A-IADL-Q IRT score than previous research (37.8 vs. 51.4) [16]. This difference could be a consequence of cultural influences, different characteristics of the sample in these two studies, and differences in the diagnostic approach when establishing a diagnosis of dementia.

Cultural differences may influence the level of IADL performance that is considered abnormal. Expectations regarding the activities of older adults within different societies can vary and lead to a lower probability of the recognition of dementia by the patient's family members and community in lower and middle-income countries such as Serbia [17]. Also, living in the urban centers of a developed country might objectively require more complex skills in everyday life than living in a smaller town or rural environment of a developing country [18].

Previous research has shown that a level of education in the general population is significantly correlated with knowledge about dementia [19] and that a lower level of knowledge about dementia can hamper timely access to medical care [20]. As the significant difference in the level of education between the two groups of patients was registered in our sample, there may be a selection bias where patients with a higher education turn to a neurologist and accept cognitive screening for less pronounced problems with cognition than patients with lower education [20,21]. The dementia group in our sample was less educated and had a lower MMSE score and a greater IADL impairment than the corresponding group in the previous research by Sikkes and colleagues [16].

Finally, a different approach to measuring cognitive impairment might explain the differences in cutoff scores. MMSE, the primary screening instrument for patients with cognitive complaints in our sample, has its limitations. Lower sensitivity leads to diagnosing dementia later than in the cases where more sensitive neuropsychological methods were used to assess cognitive impairment [22].

The diagnosis of dementia requires the clinician to differentiate this diagnostic entity from mild cognitive impairment [1]. As patients with normal cognition and severe dementia were excluded from our sample, we examined the diagnostic accuracy under conditions corresponding more closely to actual clinical practice. This approach may also explain the difference in our results compared to previous research.

A recent study in the Netherlands proposed an IADL impairment categorization related to the total IRT score of the A-IADL-Q as follows: normal (scores ≥60), mild (scores 50–59), moderate (scores 40–49) and severe (scores < 40) [11]. The authors of the proposed classification note that it represents the consensus of caregivers and clinicians in their study and that the interpretation of cut-offs may depend on individual definitions and opinions [11]. However, according to the suggested values, the cut-offs determined in our study belong to the severe IADL disorder. Considering that the A-IADL-Q was not used as a diagnostic criterion in our study, our cutoff value indicates that examining IADL based on the clinician's opinion only significantly underestimates the deficit. Objectively measured IADL using the appropriate instrument could help to diagnose dementia in an earlier phase.

ROC curve analysis didn't show a significant difference between the two methods of A-IADL-Q scoring. Both scoring methods showed similar sensitivity and specificity. The advantages of the IRT scoring method are better psychometric characteristics and a less strong ceiling effect [6]. However, WA scoring is much simpler, and this score is already available in the online platform used for IADL assessments. The authors of the validation study of the UK version of A-IADL-Q also used the WA scoring method in part of their study, which was in high concordance with the IRT scoring [23]. Our study showed that both scoring methods could be used in clinical practice and research with similar sensitivity and specificity.

The limitation of this study is the use of MMSE as a sole measure of cognition in the majority of patients, as well as the relatively small sample of patients. Also, we have included just one dementia type, dementia due to AD. Analysis of this instrument's characteristics in dementia syndromes other than Alzheimer's disease could be the aim of further studies.

Conclusion

In conclusion, we have shown that A-IADL-Q has moderate diagnostic accuracy in differentiating dementia and mild cognitive impairment. This instrument can be used in combination with cognitive measures to diagnose dementia in its early stages.

Acknowledgments: The Amsterdam IADL Questionnaire ©, 2010, VU University Medical Center, Alzheimer Center Amsterdam; All rights reserved. The Amsterdam IADL Questionnaire can be obtained from the developers after registration and is free for use in all academic, not-for-profit research and public health agencies.
(https://www.alzheimercentrum.nl/professionals/amsterdam-iadl/).
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