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Development of an International Screening Test for Language Disorders Targeting English Native Speakers

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The Screening Test for Aphasia and Dysarthria (STAD), which we developed, can be performed without burdening the patient in various settings, including bedside, in just 10 minutes (average 9 minutes and 48 seconds). Even six years after its publication, the cumulative distribution in Japan has surpassed 3,600 copies, with its issuance numbers still on the rise, anticipating further penetration in Japan. During the research period, our results were accepted by an international journal. We have also achieved international collaborative research with six speech-language pathologists (two from the USA, one from India, one from Australia, one from New Zealand, and one from Taiwan) for the validity test of the 29 items in the English version of STAD, which bodes well for its future development.

(Back ground of the study)

Cerebrovascular disease is a common and leading cause of disability worldwide. Most patients with cerebrovascular disease require some rehabilitation. While rehabilitation programs often focus on motor function impairments, cognitive impairment is another prevalent post-stroke disability, affecting up to 35% of post-stroke patients. Cognitive impairment is not simply an ancillary issue; it crucially affects long-term stroke outcomes. Post-stroke cognitive disorders have wide-reaching effects, such as hindering recovery of activities of daily living (ADL), reducing the rate of returning home, creating barriers to returning to work, impairing driving abilities, and increasing the need for post-discharge care services. Early detection in the acute stroke unit is essential for informing decision-making about interventions and for discharge planning. The natural course of post-stroke cognitive impairment indicates the importance of assessing cognitive changes over time. Therefore, whenever a complaint or a clinical concern regarding cognitive ability arises, screening is necessary.

(Aim of the study)

The Screening Test for Aphasia and Dysarthria (STAD) comprises three domains: language and articulation tests targeting common post-stroke communication disorders, such as aphasia and dysarthria, and a non-verbal test that screens cognitive functions without relying on language. A previous study, which conducted a criterion-related validity test of the STAD compared to the Western Aphasia Battery Nonlinguistic skill, reported a correlation between the Non-Verbal section and cognitive function (r = 0.79, 95% confidence interval [CI] 0.69–0.87, p<0.001). However, the relationship between the STAD Non-Verbal test scores and ADL or home discharge remains unclear. We hypothesized that if the cognitive function estimated by the STAD Non-Verbal test aligns with that measured by the MMSE or MoCA, then, given the literature indicating associations between MMSE or MoCA scores and ADL or home discharge, the STAD Non-Verbal test scores should also be related to ADL and home discharge.

(Method)

Between February and May 2018, inpatients prescribed speech–language therapy by a physician after development of cerebrovascular disease were recruited. Brain injuries included cerebral infarction, cerebral hemorrhage, and subarachnoid hemorrhage. The exclusion criteria were a low consciousness level, a severe medical condition, being <18 years, and difficulty understanding Japanese.

The Modified Rankin Scale (mRS) is one of the most representative functional outcome measures in contemporary stroke research. It is globally recognized and extensively utilized, especially preferred by physicians and nurses in emergency departments and specialized wards such as neurosurgery and neurology. In the present study, the mRS was employed as a primary tool to evaluate functional ability because of its universal implementation and ease of use. The scale ranges from 0 (indicating no symptoms at all) to 5 (denoting severe disability), with an additional score of 6 representing death. This scale provides an understanding of a patient's general condition after stroke, capturing a broad spectrum of functional outcomes. Following the approach used by Påhlman et al., we considered an mRS score of ≤2 to indicate ADL independence, while a score of >2 suggested ADL dependence. This categorization was utilized to assess the functional status and independence of patients in daily activities.

In the present study, we focused on the straightforward outcome of home discharge after hospitalization, as this directly reflects the real-world living situation. This method provided a clear, objective measure, avoiding subjective interpretations or complex assessments. A total of 172 patients were able to return home directly from the facilities. Among the remaining 135 patients who could not return home, 68 were transferred to rehabilitation hospitals, 56 to nursing homes, six to assisted living condominiums, and two to another acute hospital. The remaining three patients passed away.

The STAD was administered on average 43.7 days (standard deviation [SD]: ± 46.6) post-brain injury onset. Fifty-eight speech–language pathologists (SLPs), with an average of 7.6 (± 5.7) years of clinical experience and comprising 39 women and 19 men, conducted the STAD assessments. All communication related to the study procedures, and any questions or uncertainties that arose during the STAD administration, were shared and addressed through an online chat application among all participating speech–language pathologists. Statistical analysis.

(Result and discussion)

To examine the interrelation between ADL dependency status and various demographic and clinical characteristics, we first categorized patients into the ADL-independent and ADL-dependent groups (n = 182) and compared variables between groups. Notably, ADL-dependent patients were about six times more likely to demonstrate cognitive impairment than their independent counterparts, with an OR of 6.34 (95%CI: 3.57–11.52, p<0.001). This association was markedly stronger than those found for aphasia (OR 1.71, 95%CI: 0.94–3.21, p=0.07) and dysarthria (OR 1.61, 95%CI: 0.95–2.73, p=0.08). Significant differences were also observed in age (t = -3.30, df = 200.7, p<0.005) and home discharge ability (OR 6.28, 95%CI: 3.39–12.11, p<0.001).

To explore the relationship between discharge destinations and various demographic and clinical characteristics further, we compared patients who were discharged to their homes (n = 152) with those who were not discharged home (n = 126) following their STAD assessment at the hospital (Table 2). The likelihood of cognitive disorder among those unable to return home was significantly elevated (OR 2.78, 95%CI: 1.65–4.73, p<0.001), which was a more pronounced correlation than that observed with aphasia (OR 1.50, 95%CI: 0.86–2.61, p=0.14) and dysarthria (OR 1.38, 95%CI: 0.83–2.28, p=0.23). Significant associations were also noted between age (t = -4.20, df = 273.9, p<0.001) and MRS scores (t = -9.05, df = 276.0, p<0.001), reinforcing the interconnection between age, ADL levels, cognitive function, and home discharge.

Araki et al.'s previous investigation showed a correlation between the Verbal section of the STAD and aphasia, the Articulation section with dysarthria, and the Non-Verbal section with cognitive impairment. However, the relationship between STAD scores and ADL dependency status or home discharge has not yet been elucidated. Our study uncovered an association between Non-Verbal section scores and both the level of ADL independence and the likelihood of returning home. Crucially, in terms of effect size, Cohen's d was the highest for Non-Verbal scores for both ADL dependence and home discharge, at 0.89 and 0.98, respectively. Ad Cohen's d values of 0.2, 0.5, and 0.8 denote small, medium, and large effects, respectively, these data suggested an intense correlation of the Non-Verbal section with ADL-independence and home discharge status.

Exploratory univariate analysis suggested that the STAD non-verbal test could be effective in predicting the likelihood of a home discharge after hospitalization. Consequently, we identified factors related to home returns using multivariate analysis and evaluated the accuracy of the predictive formula. The candidate variables were age, MRS score (0–6), cognitive disorder, and STAD Verbal (0–16), Articulation (0–7), and Non-Verbal (0–6) test scores, all of which were significantly associated with returning home in the univariate analysis. After completing backward stepwise logistic regression analysis with a removal probability of 0.05, age, Articulation and Verbal test scores, and cognitive disorder were excluded from the model (Table 4). The final model, which incorporated the MRS and the Non-Verbal test score, was based on 278 participants, and bootstrap statistics were employed. The R^2 value of the model was 0.344, and it accurately identified 61.9% (123/171) of home discharge and 80.9% (78/107) of non-home discharge patients. Overall, 72.3% (201/278) of participants were correctly classified. The positive- and negative-predictive values of the model were 72.9% (123/152) and 71.9% (78/126), respectively. The area under the ROC curve for this model was 0.802 (95%CI 0.750–0.853, p<0.0001). Validation through bootstrapping with 1000 samples corroborated the model with significant (p<0.0001) odds ratios (MRS: 0.39–0.66, Non-Verbal test score: 1.22–1.89). Taken together, these findings robustly support the hypothesis that both the MRS and Non-Verbal test scores influence the home discharge outcome.

In summary, our research identified a close relationship between the STAD Non-Verbal test and outcomes such as ADL dependence status and the likelihood of returning home. The STAD Non-Verbal test measures functions similar to those assessed by the MMS and MoCA, which are also closely related to ADL dependence status and home return. The estimation of cognitive function by the STAD, without relying on language, may offer a novel clinical screening method that is less influenced by communicative disorders, such as aphasia and dysarthria, which have traditionally been challenging to incorporate into existing screening approaches. It will be of particular interest to determine whether the use of the STAD Non-Verbal test can provide a solution to the often-encountered clinical and research issues of underestimating the cognitive function in patients with communication disorders. Further investigations are required in the future.

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The Screening Test for Aphasia and Dysarthria (STAD) for patients with neurological communicative disorders: a large-scale, multicenter validation study in Japan			2021
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Predicting discharge to home and brain lesions using the Screening Test for Aphasia and Dysarthria (STAD)
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What is STAD?
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