Improving the psychometric properties of the multiple sclerosis functional composite index: replacing the PASAT-3” with a brief measure of vigilant attention. A pilot study in relapsing remitting multiple sclerosis patients

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Improving the psychometric properties of the multiple sclerosis functional composite index: replacing the PASAT-3® with a brief measure of vigilant attention.

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ABSTRACT

Aims: Both the MSFC (encompassing the PASAT 3”) and the CDR, a computerised test battery including the Digit Vigilance task, were administered to 43 relapsing remitting multiple sclerosis (RR-MS) patients repeatedly during an open-label study of INF-beta 1A. In addition, the Expanded Disability Status Scale (EDSS) was administered. The CDR System Digit Vigilance Task lasts three minutes and involves the constant presentation of a randomly selected target digit on the right hand side of the screen whilst, in the screen’s centre, a series of 450 digits is presented at the rate of 1 every 0.4 seconds (see Figure 1). The subject has to press a response button as quickly as possible every time the target digit is presented. It has shown widespread sensitivity to detect impairments in multiple sclerosis (MS) patients repeatedly during the course of a clinical trial. The aim of the present evaluation was to determine the suitability of a computerised information processing test, Digit Vigilance, to replace the PASAT in the MSFC.

INTRODUCTION

Three variables have been recommended as primary measures in a Multiple Sclerosis Functional Composite Test (MSFC), namely: 1) Timed 25-foot walk; 2) 9-hole peg test; and 3) Paced Auditory Serial Addition (PASAT 3™ version). However, several researchers have noted that the ‘cognitive’ component of the MSFC, PASAT 3™, despite having good psychometric properties in several respects (e.g. test-rest reliability), suffers from marked learning/practice effects and also ceiling effects. 1,2. Both of these issues limit the suitability of this measure, particularly in clinical trials where possible treatment related improvement in function may occur and learning/practice effects and ceiling effects could reduce the sensitivity of the measure to change, particularly improvement.

Information processing speed has been recognised as one of the primary cognitive impairments in multiple sclerosis (MS). Millisecond reaction time measures derived from computerised tasks have attractive properties as measures of information processing speed. In particular, they are essentially free of both ceiling and floor effects, but have also proven to be particularly sensitive outcomes in several prior studies. 4, 5.

METHODS

Both the MSFC (encompassing the PASAT 3™) and the CDR, a computerised test battery including the Digit Vigilance task, were administered to 43 relapsing remitting multiple sclerosis (RR-MS) patients repeatedly during an open-label study of INF-beta 1A. In addition, the Expanded Disability Status Scale (EDSS) was administered.

The CDR System Digit Vigilance Task lasts three minutes and involves the constant presentation of a randomly selected target digit on the right hand side of the screen whilst, in the screen’s centre, a series of 450 digits is presented at the rate of 1 every 0.4 seconds (see Figure 1). The subject has to press a response button as quickly as possible every time the target digit is presented. It has shown widespread sensitivity to detect impairments in multiple sclerosis (MS) patients repeatedly during the course of a clinical trial. The aim of the present evaluation was to determine the suitability of a computerised information processing test, Digit Vigilance, to replace the PASAT in the MSFC.

RESULTS

PASAT 3™ showed both a significant initial improvement (learning/practice effect) and ceiling effects, with around one quarter of patients being at ceiling from the third assessment to the end of the study (24 months) (see Table 1). Furthermore, PASAT 3™ is the only measure that is different at different time points, due to learning/practice improvement effects (see Table 2). Contrarily, the Digit Vigilance measure showed no evidence of learning/practice effects and does not have a ceiling or floor. Changes over time for the PASAT 3™ and Digit Vigilance tasks are shown in Figures 2 and 3. The peak improvement in the PASAT 3™ shows an effect size of 1.2, which is large. The decline seen at month 24 with the Digit Vigilance task has a small to medium effect size of 0.3. Test-retest for the PASAT 3™ was slightly lower than for the PASAT 3™, but was still in the ‘good’ to ‘excellent’ range (>0.8), as shown in Table 3. For the revised MSFC, test-retest was similar to that for the standard PASAT 3™. The task measured the psychometric properties, absence of learning/practice and ceiling effects make it more suitable as a clinical trials outcome. In addition, some of the operational requirements, specialised administration and scoring and paper data capture, which make it less suited to clinical trials. In comparison, the Digit Vigilance task, which is part of an automated battery of tests, does not require specialist administration and captures data electronically. Digit Vigilance only uses Arabic numerals as task stimuli and is therefore bespoke response box specially designed to minimise the motor component.

DISCUSSION

Both the PASAT 3™ and Digit Vigilance tasks are brief (approximately five minutes in total) assessments of information processing, with adequate psychometric properties when used as the ‘cognitive’ assessment in the MSFC. However, Digit Vigilance has the advantage of an absence of marked learning/practice effects and ceiling effects. Whilst PASAT is well suited to assessment in clinical practice, it has a number of features such as language requirements, specialised administration and scoring and paper data capture, which make it less suited to clinical trials. In comparison, the Digit Vigilance task, which is part of an automated battery of tests, does not require specialist administration and captures data electronically. Digit Vigilance only uses Arabic numerals as task stimuli and is therefore largely language free, except for task instructions. The Digit Vigilance task does necessitate a hand/arm motor response, as opposed to the verbal responding in the PASAT, but this does not appear to adversely affect psychometric properties and the responding is via a bespoke response box specially designed to minimise the motor component.

CONCLUSIONS

Digit Vigilance is a suitable replacement for PASAT 3™ in the MSFC and its psychometric properties, absence of learning/practice and ceiling effects make it more suitable as a clinical trials outcomes. In addition, some of the operational advantages of the Digit Vigilance task may be particularly suited to large multicentre, multi-national clinical trials in multiple sclerosis.

REFERENCES


DISCLOSURE

The authors were all employed by Bracket at the time this research was performed. Bracket provides the CDR System as a service in clinical trials.