Schizophrenia Research 166 (2015) 304–309

Contents lists available at ScienceDirect

Schizophrenia Research

journal homepage: www.elsevier.com/locate/schres

Examination of the validity of the Brief Neurocognitive Assessment (BNA) for schizophrenia

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ARTICLE INFO

Article history:
Received 18 November 2014
Received in revised form 6 May 2015
Accepted 7 May 2015
Available online 23 May 2015

Keywords:
Neuropsychological testing
Generalized cognitive impairment
Processing speed
Working memory
Psychosis
Functional competence
Reliable change index

ABSTRACT

Background: Although many comprehensive batteries exist to evaluate the nature and degree of cognitive impairments in patients with schizophrenia, short batteries hold promise for rapidly screening and estimating deficits in global cognition. Recently, the Brief Neurocognitive Assessment (BNA) was established and has been shown to have similar validity and utility to a more comprehensive battery of cognitive tests in evaluating global cognitive impairments in patients with schizophrenia. The present study sought to further establish the validity of the BNA by comparing it with the MATRICS Consensus Cognitive Battery (MCCB).
Methods: One-hundred seventy-six patients with schizophrenia and 300 healthy volunteers participated in the present study. Global cognition was evaluated using the MCCB composite score and estimated using the BNA. To examine practice effects and test–retest reliability, patients were re-assessed after 4 weeks.
Results: The BNA was highly correlated with global cognition as evaluated by the MCCB in both the schizophrenia ($r = 0.82$) and healthy control samples ($r = 0.75$). Both instruments were similarly sensitive to deficits in global cognition in patients with schizophrenia relative to healthy controls. The BNA also demonstrated high test–retest reliability in patients with schizophrenia ($r = 0.87$), comparable to the level observed with the MCCB ($r = 0.91$). In addition, both the BNA and MCCB showed a similar level of practice effects (both Cohen's d = 0.11), and both instruments demonstrated equivalent sensitivities to longitudinal change. Furthermore, scores from the BNA and MCCB were related to symptom severity and functional capacity to a similar degree.
Conclusions: The BNA provides clinicians and researchers with an efficient and reliable means by which to evaluate global neurocognitive impairments in patients with schizophrenia by allowing estimation of performance on a more comprehensive standardized battery.

1. Introduction

Individuals with schizophrenia present with a constellation of signs and symptoms including positive and negative symptoms, and cognitive dysfunction (Tandon et al., 2009). Despite substantial development of treatments to address positive symptoms, treatments for cognitive impairment and negative symptoms have been more elusive (Kirkpatrick et al., 2006; Keefe et al., 2013). The significance of this question is underscored by the fact that these latter symptoms have been consistently linked to patients' functional outcome (Mohamed et al., 2008; Shamsi et al., 2011; Fervaha et al., 2014b).

The recent focus on cognitive functioning, especially in terms of its impact on outcomes, has resulted in increased interest in assessing this aspect of schizophrenia. There are numerous neuropsychological test batteries that may be administered to assess the degree of patients' cognitive impairment. Notably, the MATRICS (Measurement and Treatment Research to Improve Cognition in Schizophrenia) Consensus Cognitive Battery (MCCB) represents the current "gold standard" among tools for the assessment of cognitive impairment, especially in the context of clinical trials evaluating the efficacy of cognition-enhancing agents (Nuechterlein et al., 2008; Buchanan et al., 2011). However, comprehensive batteries can be lengthy for both patients and examiners, potentially precluding its widespread use in situations where cognition would not be otherwise evaluated (e.g., routine clinical practice, research protocols not focused on cognition). The MCCB requires approximately 65 min of administration time. A brief assessment tool may offer some advantages in this regard by providing researchers and clinicians a means of rapidly evaluating the degree of global cognitive impairment

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http://dx.doi.org/10.1016/j.schres.2015.05.015
0920-9964/

in patients. However, it should be recognized that abbreviated batteries cannot (by definition) evaluate the full degree and profile of cognitive impairments. Nonetheless, knowledge of global impairment is relevant for both clinical and research purposes (e.g., patient characterization in research protocols).

Several abbreviated batteries have been proposed, such as the Brief Assessment of Cognition in Schizophrenia (BACS) (Keefe et al., 2004), the Repeatable Battery for the Assessment of Neuropsychological Scale (RBANS) (Gold et al., 1999), the Brief Cognitive Assessment (BCA) (Velligan et al., 2004), and the Brief Cognitive Assessment Tool for Schizophrenia (B-CATS) (Hurford et al., 2011). These batteries do, in fact, require less administration time than more comprehensive batteries such as the MCCB, but it remains unclear whether the scores are comparable. Further, it is unknown whether scores from shorter batteries are related to clinically relevant variables, such as functioning, to a similar degree as scores from longer cognitive batteries within the same participants. This is a necessary feature for these batteries if they are to be employed in empirical research as a proxy for scores derived from more comprehensive batteries. Though it should be noted that scores from at least some of these abbreviated batteries are related to the functional status of patients with schizophrenia (Gold et al., 1999; Velligan et al., 2004; Keefe et al., 2006); however, whether the magnitude of this relationship is similar or different to the relationship found when scores derived from more comprehensive cognitive batteries are utilized is not clear.

In a previous study with schizophrenia patients we empirically established a brief neurocognitive assessment (BNA) tool, comprised of two cognitive tests that require up to 10 min of administration time, and showed that scores from the BNA were highly related to global cognition scores derived from a more comprehensive battery that takes about 90 min to administer (Fervaha et al., 2014a). We further demonstrated that global cognition scores, derived from either the BNA or the longer battery, were related to symptom severity and functional outcome, even in multivariate models, suggesting that scores from these two assessment tools are highly similar (Fervaha et al., 2014a). Given that the field has embraced the MCCB as the "gold standard" assessment tool for cognitive impairment in people with schizophrenia, it is important to know whether brief batteries first overlap with scores from the MCCB and, second and perhaps more importantly, show similar relationships with other clinical variables.

In this present study we sought to further examine the reliability and validity of the BNA by comparing and contrasting it with the MCCB. First, we examined the validity of the BNA in estimating global cognition scores by evaluating the amount of overlap with MCCB scores in patients with schizophrenia. Second, we extended this validation to healthy comparison subjects to examine if the BNA was valid in estimating global cognition in these participants as well. Third, we evaluated the test–retest reliability of the BNA and compared this with the MCCB. Finally, in order to establish the utility of the BNA, we compared the relationships between the BNA and important external variables such as symptom severity and functional capacity against the relationships between MCCB and the same external variables.

2. Methods

2.1. Participants

Data were drawn from the MATRICS Psychometric and Standardization Study (Kern et al., 2008; Nuechterlein et al., 2008). The objective of the MATRICS study was to create a cognitive battery that can be used in clinical trials evaluating cognition-enhancing agents in people with schizophrenia. Participants were recruited from 5 study sites (University of California Los Angeles, Duke University, Maryland Psychiatric Research Centre, Massachusetts Mental Health Centre, and University of Kansas). Each of these locations contributed approximately 30 participants each, with the final number of participants being 176. Patients had a diagnosis of schizophrenia or schizoaffective disorder (depressive type) confirmed using the Structured Clinical Interview for DSM-IV (First, 1997), were clinically stable, and did not change medications in the past month. All participants were administered the baseline assessments and 167 (95%) were re-assessed 4 weeks later.

In addition, 300 healthy controls were also recruited from the same 5 sites and were stratified by age, gender, and education. Inclusion and exclusion criteria for both patients and healthy controls have been reported elsewhere (Kern et al., 2008; Nuechterlein et al., 2008).

2.2. Measures

The composite score from the MCCB was used as a measure of global cognition (Nuechterlein et al., 2008). The MCCB consists of 7 cognitive domains, each with one to three tests. Speed of processing was measured using Part A of the Trail Making Test, the Symbol Coding subtest of the BACS and the Category Fluency Test. Attention and vigilance were evaluated using the Identical Pairs version of the Continuous Performance Test. The spatial span subtest of the Wechsler Memory Scale was used to measure non-verbal working memory, while the Letter-Number Span test was used for verbal working memory; both tests comprised the working memory domain. For verbal learning the Revised Hopkins Verbal Learning Test was selected. Visual learning was measured via the Revised Brief Visuospatial Memory Test. Reasoning and problem solving were measured using the Neuropsychological Assessment Battery mazes subtest. Finally, social cognition was measured via the managing emotion branch of the Mayer–Salovey–Caruso Emotional Intelligence Test. The MCCB takes approximately 65 min for test administration, which excludes potential breaks between tests and time required for scoring. Though the MCCB is considered a comprehensive battery in the sense that it covers most

Table 1
Description of tests included in the Brief Neurocognitive Assessment.

Test	Description	Example trial	Scoring and norms [a]	Estimated administration time (min)
Letter–Number Span Test	A sequence of letters intermixed with number is read aloud to the subject. The subject must reorganize this sequence and list first the number in order from lowest to highest followed by letter in alphabetical order.	Experimenter reads: H-5-T-3-J-1 Correct response: 1-3-5-H-J-T	Total number of correct sequences. Mean = 15.8; SD = 3.4	6
Symbol Coding Test	The subject is shown an item key with two rows. The top row has 9 unique symbols and below each of these are digits 1–9. Below this key, there are rows of symbols with the numbers missing. The subject must write the number that corresponds with each symbol.	Item key: $ % @ 1 2 3 Subject Response Box: % @ $ 2	Total number of correct digit-symbol pairs completed in 90 s. Mean = 56.7; SD = 10.8	3

[a] Note: The means and standard deviations provided as normative data are estimations based on data from 300 healthy community volunteers between the ages of 20 and 59 years including both males and females. It should also be noted that these values are sensitive to age and gender.