Report and Opinion

Reliability and validity of The MATRICS Consensus Cognitive Battery (MCCB): A systematic review

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Abstract: This paper summarized and analyzed domestic and foreign literatures related to the reliability and validity of The MATRICS Consensus Cognitive Battery published in the past to provide a basis for better use of this tool. [Tingting Li, Huilan Xu, Wei Liu. **Reliability and validity of The MATRICS Consensus Cognitive Battery (MCCB): A systematic review.** *Rep Opinion* 2020;12(3):84-88]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 4. doi:10.7537/marsroj120320.04.

Key words: MATRICS Consensus Cognitive Battery; Reliability; Validity; Cognitive; Psychopath

1. Introduction

One of the core symptoms of psychiatric diseases such as schizophrenia is impairment of cognitive function, which is one of the important functions of higher brain functions and also the key problem of modern rehabilitation medicine research (Kazutaka et al, 2018). Many domestic and foreign scholars have shown that cognitive dysfunction is widespread in patients with schizophrenia, and there is widespread functional impairment (Shuiyuan, 1999; Spieker et al, 2002). Cognitive impairment occurs early in schizophrenia and persists for a long time. Even after the relief of other psychiatric symptoms, cognitive dysfunction still exists. Cognitive dysfunction mainly involves multiple disorders such as memory, attention, speech, etc. The improvement of cognitive function is directly related to the recovery of social function and the improvement of quality of life in patients with schizophrenia (Green et al, 2004; Volk and Lewis, 2002; Alptekin et al, 2005; Milev et al, 2005).

The premise of improving the cognitive function of patients with mental illness is to have reliable assessment tools to assess their cognitive function. There are three main types of methods to assess cognitive function: neuropsychological assessment, electrophysiological assessment and functional brain imaging (Shao et al, 2017). In addition, foreign carried out multiple multicenter, large sample study, to assess cognitive function in patients with psychiatric research tool, has completed the research purpose is to hope that these research tool on cognitive function in patients with evaluation is meaningful, can predict its further application functions, and application in the assessment after treatment intervention to improve cognitive function (Shamsi et al, 2011; wei, 2018).

In recent years, The MATRICS consensus cognitive battery (MCCB) has been recognized as a tool to evaluate the cognitive function of psychiatric patients at home and abroad. The MCCB was initially developed by more than 130 scientists from academia, government and the pharmaceutical industry to evaluate cognition-enhancing agents and other interventions aimed at improving the cognitive deficits in psychosis (Nuechterlein et al, 2008). Similarly, the academic community, particularly in the areas of neurocognition and neuropharmacology, has responded strongly and enthusiastically to the development of MCCB (Green and Nuechterlein, 2004). The MCCB taps the following domains: attention/vigilance, working memory, verbal learning, visual learning, speed of processing, reasoning and problem solving, and social cognition.

2. Materials and methods
2.1 Search strategy

Two authors by searching PubMed, Web of science, Springer Link and the Chinese databases (CNKI, and Wan Fang). The search terms included: MATRICS consensus cognitive battery, reliability, validity, schizophrenia. All studies from inception to December 2019 were reviewed. Both indexing and free text search were used. No language restriction was set. The keywords were used in combination with the Boolean operators AND, OR, and NOT. The references of included articles were also screened to identify additional relevant studies.

2.2 Study selection criteria

Studies were included if performance was evaluated the reliability and validity of The MATRICS Consensus Cognitive Battery (MCCB). The specific review criteria were as follows, i) if a study included the reliability and validity of the MCCB and another battery assessment, independent assessment of the MCCB was required; ii) Cognitive performance was

assessed using the MCCB; articles that used tests not covered by MCCB were excluded; iii) A healthy control (HC) group was included in the study. Review articles and case reports were not considered. If data were provided but were incomplete for the current aim, the articles were excluded. Studies to be included for the review were assessed by authors Tingting Li and Wei Liu independently. Where the authors' opinions differs a corresponding author was consulted.
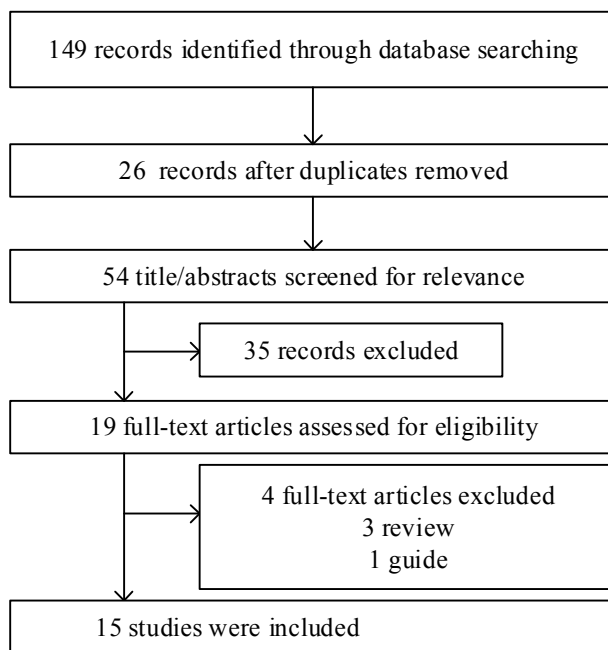
3. Results
3.1 Included studies
As shown in Fig 1, 54 studies were identified in the initial literature search. Of these, 19 were examined in detail, and that this led to 4 studies were excluded, leaving 15 in the review.

Table 1 summarizes the characteristics of the 6 studies that met the eligibility criteria for review in full. Thirteen studies were published in English and two in Chinese.

Fig 1. Literature search flow.

149 records identified through database searching

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26 records after duplicates removed

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54 title/abstracts screened for relevance

→ 35 records excluded

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19 full-text articles assessed for eligibility

→ 4 full-text articles excluded
3 review
1 guide

↓

15 studies were included

3.2 Current situation of overseas research
Since its initial development, MCCB has been used many times in different locations and populations, and its significance in assessing cognitive function is well documented. For example, Sharon (2011) and colleagues shows that the MCCB was highly sensitive to the type and level of impairment typically observed in schizophrenia and the MCCB domain scores were generally moderately–highly intercorrelated. Burton C Z (2013) and colleagues' study reported 183 outpatients with schizophrenia or schizoaffective disorder, suggesting that the MCCB subtests were highly correlated with schizophrenia especially symbol coding proved to be the best single predictor of overall cognitive performance, and cognitive impairment is common in schizophrenia. This finding is consistent with research by Dickinson (2008;2009) and colleagues in 2008 and 2009.

Norway was the first country to translate and introduce the use of the MCCB. This is the first international reference study of neurocognitive function as assessed by the MATRICS (Measurement and Treatment Research to Improve Cognition in Schizophrenia) Consensus Cognitive Battery (MCCB) and suggests that the MCCB is well suited to Norwegian research purposes and clinical applications (Mohn et al, 2012). For the MCCB in Spain, which are comparable to those effects described for the original standardized English version in the U.S (Rodriguez-Jimenez et al, 2012). A growing number of related studies have shown that MCCB is becoming increasingly popular as an effective tool for assessing cognitive function in psychiatric disorders, both in its component tests and in its suite (Rasmusson et al, 1998; Burdick et al, 2011; Kern et al, 2011).

3.3 Research status in China
In September 2008, Keith Nuechterlein signed the contract with Xin Yu to establish the China MCCB norms. The contract provided authorization and part of funding for the MCCB norm study in China (Shi et al, 2015). The practice effects were minor and test-retest reliability of MCCB was good, which suggests MCCB as an appropriate measure for clinical and research usage in China (Shi et al, 2015). In 2006, Chinese scholar Yizhuang Zou (2009) and his colleagues introduced the English version of MCCB, and organized experts in Beijing Hui Long Guan Hospital to translate, translate back, revise, test, standardize and computerize the MCCB, and evaluated the clinical reliability and validity of the Chinese version. This indicated that the Chinese version of MCCB was used as a standardized measurement tool to evaluate the effect of cognitive impairment treatment in patients with schizophrenia. Compared with other functional scales, the results of MCCB were more stable and reliable (Jiefeng et al, 2009). The MCCB subtest is not only used for schizophrenia but also for other mental disorders, and the evaluation results have good reliability and validity.

4. Discussion
Since its original development, many studies in various locations and populations report that MCCB assessments have high test-retest reliability (Keefe et al, 2011; Javitt et al,2012; Buchanan et al, 2011), low practice effects (Keefe et al, 2011; Buchanan et al, 2011) and high completeness rates (Keefe et al, 2011).

Table 1. Studies included in review

Author (year)	Sample N	Source of the patient	Male N	Age (year)	Education (year)	The reliability and validity of the MCCB	Note
Steven M. Silverstein, 2010	Sch① 155 HC② 75	outpatients or partial hospital patients	102	18-55	none	all participants, the average reliability coefficients (r⑧) are 0.81;schizophrenia participants：0.67;controls：0.79	For the MCCB, the total amount of calculable missing data across all tests was 0.89%, and the percentage of patients whose datasets contained missing data was 11.30%.
Attilio Rapisarda, 2013	Healthy ethnic Chinese, Malay, and Indian English speakers (N = 171)	none	87	21-39 (SD=28.3) 40-49 (SD=44.9) 50-61 (SD=53.9)	the least-educated (LE) participants (19.3%) had 6 to 9 years of education	Age, education, and ethnicity affected the battery's composite scores, with young and highly educated participants generally outperforming the old, less-educated ones.	Comparison with United States norms
Jane Lees, 2015	schizophrenia or schizoaffective disorder 143	none	102	Mean=39.2	Median length of full time education was 12 years	baselines1, MCCB domains r=0.69–0.90; baselines2, MCCB domains r=0.62–0.87.	Test-retst in the baseline 1 and 2
Richard S.E. Keefe, 2010	Sch 323	outpatients	231	18-65	none	ICC④=0.88	14 were invalid or missing Three hundred eighteen of the 323 patients (98.5%) had complete MCCB assessments at screening and baseline
Bradley E. Gray, 2014	Sch 159	none	118	Mean=44.3	Mean=12.4	r = 0.91, p<0.001, ICC= 0.91, p<0.001	none
Gagan Fervaha, 2015	Sch 167 HC 300	From 5 study sites , were clinically stable, and did not change medications in the past month.	Sch 74.7% HC 46.0%	Sch (Mean=40.3) HC (Mean=42.6)	Sch (Mean=12.4) HC (Mean=14.3)	Sch (r=0.91,p<0.001)	Only patients were re-assessed after 4 weeks
Christine Mohn, Ph.D., 2017	Sch 131 HC 300	local mental health centers and vocational services	Sch 92 HC 149	Sch (Mean=33.0) HC (Mean=39.4)	Sch (Mean=11.8) HC (Mean=12.2)	The theoretical domain structure of the MCCB could not be demonstrated in these Norwegian participants. Consonant with US studies, models with three and two factors had mediocre fit, and in the schizophrenia spectrum disorder group only. In both groups, the subtests symbol coding, working memory, and learning were the most sensitive in tapping general neurocognitive performance, supporting US models.	Exploratory and confirmatory factor analysis and regression analysis.
Cynthia Z. Burton, 2013	183	outpatients with schizophrenia or schizoaffective disorder	127	Mean=44.45	Mean=13.00	Symbol coding, spatial span, and visual learning were the most robust predictors for each of the three factors; symbol coding proved to be the best single predictor of overall cognitive performance,processing speed is a fundamental cognitive deficit in schizophrenia and that MCCB performance is related to functional capacity.	Confirmatory factor analysis
Yasuhiro Kaneda, 2013	Sch 37	none	23	Mean=38.4	Mean=13.3	Cronbach's alpha for the MCCB-J was 0.72.	none
Keith H. Nuechterlein, Ph.D., 2008	167	From 5 study sites , each site contributed at least 30 participants with schizophrenia or schizoaffective disorder, depressed type .	0.76	Mean=44.0	Mean=12.4	Test-retest reliabilities were generally good. The committee considered an r value of 0.70 to be acceptable test-retest reliability for clinical trials. Most of the tests achieved at least that level.	The expert panel ratings are presented for the initially selected 36 tests. 10 tests were selected to represent seven cognitive domains in the MATRICS Consensus Cognitive Battery.
Anastasia Georgiades, 2017	2616	Clinical trials of the United States (94%) and Canada (6%).	1782	Mean age (± SD) was 42.7 ± 10.52	none	The test–retest reliability as measured by the ICC was 0.88 for both the cognitive and neurocognitive composite scores. The test–retest reliability of the individual domains was variable, ranging from ICC = 0.61 for Verbal Learning to ICC = 0.81 for Speed of Processing.	The MCCB was administered twice prior to the initiation of treatment in 1908 patients.
Ana Olívia Fonseca, 2017	Sch 99 HC 99	Outpatients with schizophrenia	Sch 52.5% HC 52.5%	Sch (Mean=37.57) HC (Mean=37.55)	Sch (Mean=10.74) HC (Mean=11.12)	All Pearson's correlations were in the 0.70s and 0.80s except for the LNS and HVLT-R, which were in the 0.60s, and MSCEIT-ME, which was 0.55 .	Forty-five patients with schizophrenia were retested thirty days later by the same examiner.
Chuan Shi, 2015	HC 656	Uninvolved	0.503	20–59	At least 5 years of education	In terms of test-retest reliability, the ICC of nine cognitive subtests varied from 0.73 to 0.94, the lowest being MCSEIT Managing Emotion (ICC = 0.73) and the highest being BACS Symbol Coding (ICC = 0.94). The ICC for whole test battery (Composite score) was 0.95.	none
Malgorzata Jedrasik-Styla, 2015	Sch 61	inpatients and outpatients	0.66	Mean=34.43	Mean=14	The test–retest reliability for the composite score was very high, r (59) = 0.93, p<0.001.	none
Zou, Y., 2009	Sch 122	inpatients	84	Mean=45	Mean=12	The test-retest reliability of MCCB composite score was 0.88(P<0.001)．and inter-raters reliability Icc of 0.97(P<0.001).	none

Note：① Sch= schizophrenia. ② HC= Health Control ③ r = Pearson product－moment correlation coefficient ④ ICC= Intraclass Correlation Coefficient

In addition, a number of studies suggest that MCCB is sensitive to treatment effects (Green et al, 2014). Most of these studies aimed to test the test-retest reliability of MCCB, the factor structure of MCCB, or the inter-relations of the different cognitive domains assessed by MCCB, so they selected subjects or cohorts of participants who were clinically stable and educated enough to complete all the MCCB sub-tests（Keefe et al, 2011; Mohn et al, 2017）. The main standardization study of the Chinese MCCB (Shi et al, 2015) was limited to subjects with at least 5 years of education, and its psychometric properties were assessed in stable inpatients and healthy controls with a mean (SD) of 12 (2) years of education (Zou et al, 2009).

Globally the majority of individuals with schizophrenia and other chronic psychoses live in the rural parts of low- and middle-income countries where the level of education is typically low and standard mental health services are either limited or non-existent. Many of these individuals do not have the level of education or the clinically stable illness typically required for participation in MCCB validation studies. And the MCCB composite score has been proposed to be the optimal primary outcome measure, though its validity is unknown (Burton et al, 2013). Thus, the validity and utility of MCCB for assessing cognitive function in individuals living in these less advantaged settings remains to be demonstrated.

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