Journal of Rehabilitation Sciences and Research

Journal Home Page: jrsr.sums.ac.ir

JRSR

Original Article

Psychometric Evaluation of the Persian Version of the Dysexecutive Questionnaire in Methamphetamine-Abstinent Individuals

Majid Farhadian[1], PhD candidate; Malahat Akbarfahimi[1*], PhD; Peyman Hassani Abharian[2], MD-PhD

[1]Department of Occupational Therapy, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran
[2]Institute for Cognitive Sciences Studies (ICSS), Tehran, Iran

ABSTRACT

Background: Methamphetamine addiction is a growing global concern associated with executive dysfunctions that negatively impact daily life. Traditional tests for assessing executive dysfunctions are often complex and time-consuming. Therefore, a valid, reliable, and simple instrument to assess these dysfunctions is crucial. This study aimed to assess the psychometric properties of the Persian version of the Dysexecutive Questionnaire in methamphetamine-abstinent individuals.

Methods: A cross-sectional study was conducted with 100 participants aged 20 to 50, selected via convenience sampling. The Dysexecutive Questionnaire (informant and occupational therapist ratings), Behavioral Assessment of the Dysexecutive Syndrome, Stroop test, Wisconsin Card Sorting test, and Tower of London task were used to evaluate the participants. The study examined the face validity, convergent validity, internal consistency, test-retest reliability, and inter-rater reliability of the Dysexecutive Questionnaire. Data analysis was conducted using SPSS v.23.0 at a significance level 0.05.

Results: The Dysexecutive Questionnaire demonstrated acceptable face validity (impact score: 1.95 to 3.86). Convergent validity was supported by significant correlations between the Dysexecutive Questionnaire - informant rating and other assessment tools ($P<0.001$). The questionnaire showed good to excellent internal consistency (Dysexecutive Questionnaire - occupational therapist rating: $\alpha=0.91$; Dysexecutive Questionnaire - informant rating: $\alpha=0.87$). The test-retest reliability was high for the occupational therapist rating (ICC=0.911) and informant rating (ICC=0.925). Inter-rater reliability was also excellent (ICC=0.980).

Conclusion: The Dysexecutive Questionnaire - informant rating is a reliable and valid instrument for evaluating dysexecutive symptoms in methamphetamine-abstinent individuals.

Introduction

Methamphetamine (MA) is a highly addictive psychostimulant drug that is abused worldwide. Its usage is associated with numerous health risks, including the spread of infectious diseases, cardiovascular and renal failure, and various mental disorders, such as psychosis [1]. Even after several months of abstinence [2], individuals who have used MA exhibit impaired social-cognitive functions and a decline in their ability to handle everyday tasks in specific domains, such as comprehension and planning, financial transactions, travel arrangements, communication skills, and medication management [3, 4].

Corresponding author: Malahat Akbarfahimi, PhD; Department of occupational therapy, School of Rehabilitation Sciences, Iran University of Medical Sciences Postal code: 15459-13487, Tehran, Iran.
Tel: +98 9123362925; **Email:** akbarfahimi.m@iums.ac.ir

Additionally, MA dependence is linked to difficulties in communication, work, and recreational activities [5].

Chronic MA use is accompanied by changes in the central nervous system and neuropsychological deficits. Executive function (EF) problems are a common cognitive impairment in MA-addicted individuals [6, 7] , which can persist long after extended abstinence[8-10] and increase the risk of relapse[11]. EFs are crucial for many areas of behavior and cognition, including attentional switching, goal planning, and achievement, inhibition of no longer relevant responses, initiation and execution of strategies, self-regulation, and self-monitoring [12-14].

There are many standard clinical neuropsychological tests to measure executive functions; however, it is believed that most of them lack ecological validity [15]. These tests do not adequately represent real-world demands and are ineffective in predicting the nature and severity of patients' executive deficits in their everyday lives. Unlike most tests, the Dysexecutive Questionnaire (DEX) was developed to measure executive function complaints based on daily activities. The DEX is a three-factor questionnaire with 20 items designed to evaluate daily behavior, emotion, and cognition changes after neuropathology. Both the patient (self-rating: DEX-S) and a close relative of the patient (independent rating: DEX-I) complete the DEX.

This questionnaire has received attention in recent years and has been used in research on executive function. Several versions of the DEX in different languages, including Persian, German, Japanese, and English, have shown acceptable psychometric properties in preliminary studies. In addition, the DEX has been widely applied as a sensitive measure of executive dysfunction to test various neurobehavioral alterations, such as brain damage [16], schizophrenia [17], substance addiction [18], and Alzheimer's disease [19].

Both the test-retest and internal reliability of the Japanese DEX were satisfactory. Factor analysis among Alzheimer's patients identified three factors: "apathy," "hyperactivity," and "the planning and monitoring process of the purposive action [20]. Additionally, other research has used exploratory factor analysis (EFA) on various datasets to investigate the factor structure of the DEX. The initial DEX EFA for the neurological sample revealed that the behavioral fractionation of the symptoms associated with dysexecutive syndrome could be divided into three main categories: emotional, cognitive, and behavioral problems [21]. Burgess et al. (1998) found that the connections between the twenty measures classified as Disinhibition, Intentionality, Executive Memory, Positive Affect, and Negative Affect could be adequately explained by a five-factor model [22]. Mooney et al. discovered that another study's four-factor approach was the most efficient. The four components are "Inhibition," "Intention," "Social Regulation," and "Abstract Problem Solving [23].

Considering the significant impact that executive functions (EFs) have on various aspects of life, occupational therapists should prioritize EFs as a crucial area of assessment and intervention. Most neuropsychological tests used to assess executive functions are complex and time-consuming; however, a rating scale such as the Dysexecutive Questionnaire (DEX) may offer certain clinical advantages over traditional neuropsychological tests. Additionally, a caregiver-provided DEX can supply real-life information about issues related to executive dysfunctions, particularly in cases where respondents cannot complete neuropsychological tests.

Therefore, this study was conducted to evaluate the psychometric properties of the Persian version of the Dysexecutive Questionnaire (DEX-P) in methamphetamine-abstinent individuals.

Methods

Study Design

This study employed a psychometric and descriptive design to evaluate the validity (face and content) and reliability (inter-rater, test-retest, internal consistency) of the Persian version of the Dysexecutive Questionnaire (DEX-P).

Participants

A total of 20 occupational therapists were recruited for the face validity assessment, while the remaining validity and reliability assessments were conducted on 100 methamphetamine-abstinent individuals. These participants were recruited using a convenience sampling method between February 2021 and August 2022. The abstinent participants were sourced from outpatient therapeutic centers (Marham, Zendegi Dobareh, Tehransar) in Tehran, Iran. All participants were assessed based on inclusion criteria by a psychiatrist responsible for enrollment in the study. The inclusion criteria for the methamphetamine-abstinent individuals were as follows: (1) Meeting the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for methamphetamine addiction; (2) not receiving any other pharmaceutical treatments concurrently; (3) no prior diagnosis of a DSM-5 disorder; (4) no history of neurological abnormalities (e.g., central nervous system neurological disorders, head injury with loss of consciousness, or seizure disorders); and (5) abstinence from alcohol and/or drugs for at least 15 days to ensure no withdrawal symptoms would occur. Additionally, routine quick urine tests were performed on these individuals to identify any drugs or their metabolites, ensuring that no drug use occurred during the abstinence period.

Procedure

The process began by obtaining permission from the original Dysexecutive Questionnaire (DEX) author to translate and adapt it into Persian. The translation process followed the forward-backward method. Two bilingual individuals, fluent in English and Persian, independently translated the questionnaire into Persian. The research team then met to compare and consolidate the translations, resulting in a final Persian version. This version was subsequently back-translated into English by two other bilingual individuals. The research team reviewed and finalized the back-translated English version, ensuring its alignment with the original version. To further ensure

translation accuracy, face validity was examined.

The Iran University of Medical Sciences Ethical Committee approved the study (IR.IUMS. REC.93.D.105.5470). Two informant ratings of the DEX were obtained: one from an occupational therapist (DEX-OT) who had conducted at least five therapeutic sessions with the participant and another from a significant other who knew the participant well (DEX-I). Additionally, an occupational therapist administered all electronically delivered executive function (EF) tests individually one to three days after the completion of the DEX. The testing session lasted approximately one hour, including breaks.

Participants were informed of the study's purpose, potential benefits, and possible risks and were assured that their participation was entirely voluntary and that they could withdraw at any time. Informed consent was obtained from all participants before administering the study instruments. To examine test-retest reliability, 41 participants (an informant and an occupational therapist) completed the DEX twice, with a two-week interval between administrations, to minimize memory effects on responses. After completing the tests, each participant received feedback on their performance.

Instruments

Behavioral Assessment of the Dysexecutive Syndrome (BADS): The BADS consists of six subtests, with a maximum total score of 24 points. The scores from each subtest are summed to obtain the battery's overall Total Score. This test battery assesses various executive functions, including planning, prioritizing, problem-solving, inhibitory control, and behavior monitoring [21].

Dysexecutive questionnaire (DEX): The DEX is a 20-item questionnaire to assess the issues commonly associated with dysexecutive syndrome. Each item is rated on a five-point Likert scale (0–4), ranging from "never" to "very often." There are two versions of the DEX: one for the individual (self-rating) and another for a family member or professional colleague who frequently interacts with the individual (informant rating). The total score ranges from 0 to 80, with higher scores indicating greater executive dysfunction [24].

Wisconsin Card Sorting Test (WCST): The WCST is used to assess set-shifting and problem-solving abilities [25]. Participants completed the computerized version of the WCST, where they were asked to match test cards to one of four target cards based on shape, color, or multiple stimuli. The participants received no instructions on how to perform the task; feedback from the computer indicated whether their responses were correct or incorrect.

Stroop test: The Stroop test measures inhibition, set-shifting, and attention [26]. Participants were required to complete a computerized version of the Stroop test, which consisted of three levels. In the first stage (color cards), the subject pressed a key corresponding to the color of a circle (blue, red, yellow, or green) that appeared on the screen. In the second stage (pilot stage), a word with mismatched colors appeared, and the subject had to press the key corresponding to the color of the word while ignoring its actual color. The third stage was similar to the second but was presented later.

Tower of London Task: The Tower of London task is commonly used to assess executive planning [27]. In this study, a computerized version of the task was used. The task began with two configurations on the screen, one on the left (start state) and one on the right (goal state). Participants were instructed to use a computer mouse to transform the start state into the goal state by following three basic rules: (1) only one ball could be moved at a time; (2) a ball could only be moved if no other ball was on top of it; and (3) the tallest peg could hold three balls, the middle peg two balls, and the shortest peg one ball. The program did not allow moves that violated these rules. Participants had to solve 12 problems of varying difficulty, requiring three to seven moves each. The task was not time-limited, and no feedback was provided on the participants' performance.

All the aforementioned executive function tests were administered electronically and provided by the SINA Company. The software automated data recording and generated an SPSS file for analysis.

Statistical Analyses

SPSS version 23 was used for the statistical analysis of the collected data. The Kolmogorov–Smirnov test was conducted to assess the normality of data distribution. To evaluate the face validity of the DEX using a quantitative method, participants were asked to rank the importance of each item on a five-point Likert scale. Items with an impact score greater than 1.5 were considered suitable for further analysis [28]. Convergent validity was examined by analyzing the correlations between the DEX and other executive function tests, including the BADS, ToL, WCST, and Stroop tests. The measure's reliability was assessed by estimating the instrument's internal consistency using Cronbach's α coefficient. The Intraclass Correlation Coefficient (ICC) was calculated to determine inter-rater and test-retest reliability.

Table 1: Demographic Characteristics of the Study Subjects

Age (years) Mean±SD	33.90±5.03
Marital status	
Married N (%)	53(53)
Single N (%)	17(17)
Widowed/Divorced N (%)	30(30)
Employment statues	
Jobless N (%)	34(34)
Full-time job N (%)	41(41)
Part-time job N (%)	25(25)
Education level	
Sub-Diploma N (%)	26(26)
Diploma N (%)	50(50)
Academic N (%)	24(24)
Duration of substance use (year)	5.12±3.14
Duration of abstinence (month)	5.86±3.05

Results

Participants

One hundred participants, 63 men, and 37 women were involved in the study. Table 1 presents the demographic information of the participants. The ratings on the DEX provided by the informants and occupational therapists did not differ significantly. Table 2 shows the results of the assessments conducted.

Table 2: Subjects' Performance Results on the Assessment Tool

	Mean±SD	minimum	maximum
DEX-OT	55.92±10.23	35	75
DEX- I	55.78±10.66	35	75
BADS	11.59±2.58	8	19
ST (Interference number)	13.49±4.26	4	23
ST (Interference time)	119.18±65.12	538	679
ToL	19.59±3.76	13	28
WCST (categories)	1.95±1.14	0	5
WCST (perseverative error)	12.37±7.39	2	36

BADS: Behavioral Assessment of the Dysexecutive Syndrome; ToL: Tower of London; WCST: Wisconsin Card Sorting Test, ST: Stroop Test; DEX-I: DEX-Independent rating; DEX- OT: DEX- Occupational Therapist rating

Table 3: Correlation Coefficients Between the Dysexecutive Questionnaire (DEX) and Neuropsychological Tests in Methamphetamine-Abstinent Individuals

	BADS	ST (Interference number)	ST (Interference time)	ToL	WCST (categories)	WCST (preservative error)
DEX- OT	-0.713**	0.075	-0.110	-0.409**	-0.478**	0.356**
DEX- I	-0.715**	0.077	-0.104	-0.409**	-0.494**	0.365**

BADS: Behavioral Assessment of the Dysexecutive Syndrome; ToL: Tower of London; WCST: Wisconsin Card Sorting Test, ST: Stroop Test; DEX-I: DEX-Independent rating; DEX- OT: DEX- Occupational Therapist rating. *<0.05; **<0.01.

Validity
Face Validity

The quantitative face validity results revealed an impact score range of 1.95 to 3.86 for the items. During this phase, occupational therapists provided suggestions on some items; however, none were deleted or modified after the final review.

Convergent Validity

The results indicated significant correlations between the DEX-OT and DEX-I and three executive function tests: BADS, ToL, and WCST. In contrast, the Stroop test did not correlate with DEX-OT or DEX-I. The correlation coefficients between the DEX and neuropsychological tests are presented in Table 3.

Internal Consistency, Inter-rater Reliability and Test-retest Reliability

The internal consistency of the DEX-I was high, with a Cronbach's α of 0.876, and the DEX-OT demonstrated even higher internal consistency, with a Cronbach's α of 0.912. Test-retest reliability was also high for both versions: DEX-I (ICC=0.925; CI: 0.841–0.971) and DEX-OT (ICC=0.911; CI: 0.833–0.953). Furthermore, the inter-rater reliability for the DEX informant rating version was excellent (ICC=0.980; CI: 0.980–0.990).

Discussion

This study investigates the psychometric properties of the Persian version of the DEX-informant rating in methamphetamine-abstinent individuals. The results demonstrate that the DEX-informant rating is valid and reliable for this population.

Initially, the validity of the DEX-informant rating was evaluated through face validity following its translation. To date, no studies have addressed the face validity of this scale. The face validity results suggest that the Persian version of the DEX is understandable and that its items are pertinent for assessing executive dysfunction. The impact scores ranged from 1.95 to 3.86, indicating

the high relevance of all items on the scale.

The correlations between the DEX-informant rating and other neuropsychological tests that measure similar constructs confirmed the convergent validity of the DEX. The data obtained in this study indicate a substantial association between the BADS, DEX-I, and DEX-OT. These findings align with previous studies utilizing the DEX-informant rating to evaluate executive dysfunctions. For instance, Wilson et al. found a significant negative association between the DEX-informant rating (based on family member assessments) and the overall BADS score [29]. Another study reported a moderate correlation between the total BADS score and DEX ratings provided by neuropsychologists or occupational therapists. In contrast, the relationship between family member ratings and the total BADS score was weaker than statistically significant. The researchers attributed this weak relationship to the timing of the evaluation during the acute period of the disease and the family members' lack of awareness of the individual's executive function problems [30].

Another study found that although there was not an especially high correlation between the BADS subtests and independent raters' scores on the DEX-informant rating, there was a significant correlation between the BADS total profile score and the DEX-informant rating [31]. The ToL and WCST also correlated with DEX-I and DEX-OT scores among the other neuropsychological tests used in this study. However, conventional tests like the WCST have not been widely employed to validate the DEX. Burgess et al. noted that, when using the DEX, the only tests that showed a significant relationship with the caregivers' assessments of dysexecutive symptom clusters were the WCST perseverative errors and Cognitive Estimates tests [32]. Similarly, Wood and Liossi found that only the Hayling and Brixton Tests had a significantly negative correlation with the DEX-informant rating, leading to the conclusion that these traditional tests have limited ecological validity [33]. Another study found a relationship between neuropsychologist and occupational therapist DEX ratings and WCST performance [34].

It is well known that impairments in executive functions involve a wide range of deficits in cognitive, behavioral, and personal systems [35-37]. Most traditional EF tests struggle to assess executive functions comprehensively because they often dissect integrated functions into their parts [38]. Therefore, these traditional tests may have limitations in terms of ecological validity, making them less effective in assessing executive functions as a multidimensional construct.

The Cronbach's alpha for DEX-I and DEX-OT was 0.876 and 0.912, respectively. These results indicate good to excellent internal consistency reliability for the DEX-informant rating administered to MA-abstinent individuals in this study. Although the original version of the DEX did not report internal consistency, some studies have reported it in different languages and contexts. Bennett et al. also found good internal consistency for the DEX, with a Cronbach's coefficient exceeding 0.91 for a group of brain-injured patients [30]. Similarly, Shinagawa et al. reported an alpha coefficient of 0.93 for the DEX-informant rating in patients with Alzheimer's disease [39]. The inter-rater reliability of the DEX-informant rating demonstrated that it could serve as a reliable tool for assessing dysexecutive syndrome. There is limited data on the inter-rater reliability of DEX ratings, and this aspect was not evaluated during the DEX's standardization [29]. However, Bennett, Ong, and Ponsford used the DEX to assess dysexecutive syndrome in an acute rehabilitation setting, showing a correlation between occupational therapist and neuropsychologist ratings on the DEX. They suggested that family members and patients might provide less accurate information, making it preferable for the DEX to be completed by professional personnel [30]. In another study, Barker et al. found a moderate correlation for DEX ratings when completed by non-clinician raters, suggesting that clinicians should be cautious in selecting family members to complete DEX-I ratings and should provide additional instructions to them [40].

The current study had some potential limitations. Instead of using a large sample from the general population, it involved a limited number of patients from treatment centers. Several moderating factors, such as usage frequency and total cumulative dose might have influenced the cognitive function of MA abusers. These moderating variables were not sufficiently defined to be included in the present investigation.

Conclusion

The present study represents an initial step in evaluating the psychometric properties of a well-known instrument to explore the impact of MA dependence on executive functions following abstinence. The findings suggest that the Persian version of the DEX-informant rating could be useful in detecting problems associated with dysexecutive symptoms in this population. These results position the DEX as a valid and reliable tool for assessing executive functions in both research and clinical settings and for planning interventions for individuals with substance use disorders.

References

1. Degenhardt L, Sara G, McKetin R, Roxburgh A, Dobbins T, Farrell M, et al. Crystalline methamphetamine use and methamphetamine-related harms in Australia. Drug and Alcohol Review. 2017;36(2):160-70.
2. Rendell PG, Mazur M, Henry JD. Prospective memory impairment in former users of methamphetamine. Psychopharmacology. 2009;203(3):609-16.
3. Homer BD, Solomon TM, Moeller RW, Mascia A, DeRaleau L, Halkitis PN. Methamphetamine abuse and impairment of social functioning: a review of the underlying neurophysiological causes and behavioral implications. Psychological bulletin. 2008;134(2):301.
4. Henry BL, Minassian A, Perry W. Effect of methamphetamine dependence on everyday functional ability. Addictive behaviors. 2010;35(6):593-8.
5. Sadek JR, Vigil O, Grant I, Heaton RK, group H. The impact of neuropsychological functioning and depressed mood on functional complaints in HIV-1 infection and methamphetamine dependence. Journal of Clinical and Experimental Neuropsychology. 2007;29(3):266-76.
6. Barr AM, Panenka WJ, MacEwan GW, Thornton AE, Lang DJ, Honer WG, et al. The need for speed: an update on methamphetamine addiction. Journal of Psychiatry and Neuroscience. 2006;31(5):301.
7. Scott JC, Woods SP, Matt GE, Meyer RA, Heaton RK, Atkinson JH, et al. Neurocognitive effects of methamphetamine: a critical review and meta-analysis. Neuropsychology review. 2007;17(3):275-97.
8. Johanson C-E, Frey KA, Lundahl LH, Keenan P, Lockhart N, Roll J, et al. Cognitive function and nigrostriatal markers in abstinent methamphetamine abusers. Psychopharmacology. 2006;185(3):327-38.
9. Salo R, Nordahl TE, Possin K, Leamon M, Gibson DR, Galloway GP, et al. Preliminary evidence of reduced cognitive inhibition in methamphetamine-dependent individuals. Psychiatry research. 2002;111(1):65-74.
10. Farhadian M, Akbarfahimi M, Abharian PH, Hosseini SG, Shokri S. Assessment of executive functions in methamphetamine-addicted individuals: Emphasis on duration of addiction and abstinence. Basic and Clinical Neuroscience. 2017;8(2):147.
11. Gorelick DA, Levin KH, Copersino ML, Heishman SJ, Liu F, Boggs DL, et al. Diagnostic criteria for cannabis withdrawal syndrome. Drug and alcohol dependence. 2012;123(1-3):141-7.
12. Burgess PW, Shallice T. Response suppression, initiation and strategy use following frontal lobe lesions. Neuropsychologia. 1996;34(4):263-72.
13. Robbins TW. Shifting and stopping: fronto-striatal substrates, neurochemical modulation and clinical implications. Philosophical Transactions of the Royal Society of London B: Biological Sciences. 2007;362(1481):917-32.
14. Stuss DT, Levine B. Adult clinical neuropsychology: lessons from studies of the frontal lobes. Annual review of psychology. 2002;53(1):401-33.
15. Burgess PW, Alderman N, Forbes C, Costello A, MA COATES L, Dawson DR, et al. The case for the development and use of "ecologically valid" measures of executive function in experimental and clinical neuropsychology. Journal of the International Neuropsychological Society. 2006;12(02):194-209.
16. Quinn AC, Bhargava D, Al-Tamimi YZ, Clark MJ, Ross SA, Tennant A. Self-perceived health status following aneurysmal subarachnoid haemorrhage: a cohort study. BMJ open. 2014;4(4):e003932.
17. Chan RC, Chen EY. Assessment of executive function for schizophrenia in Hong Kong. Hong Kong Journal of Psychiatry. 2005;15(1):23.

18. Llanero-Luque M, Ruiz-Sánchez de León J, Pedrero-Pérez E, Olivar-Arroyo A, Bouso-Saiz J, Rojo-Mota G, et al. Sintomatología disejecutiva en adictos a sustancias en tratamiento mediante la versión española del cuestionario disejecutivo (DEX-Sp). Revista de Neurología. 2008;47(9):457-63.

19. Piquard A, Derouesné C, Meininger V, Lacomblez L. [DEX and executive dysfunction in activities of daily living in Alzheimer's disease and frontotemporal dementia]. Psychologie & neuropsychiatrie du vieillissement. 2010;8(3):215-24; quiz 25-7.

20. Shinagawa Y, Nakaaki S, Hongo J, Murata Y, Sato J, Matsui T, et al. Reliability and validity of the Japanese version of the Dysexecutive Questionnaire (DEX) in Alzheimer's disease: validation of a behavioral rating scale to assess dysexecutive symptoms in Japanese patients with Alzheimer's disease. International Journal of Geriatric Psychiatry: A journal of the psychiatry of late life and allied sciences. 2007;22(10):951-6.

21. Wilson B, Alderman N, Burgess P, Emslie H, Evans J. Behavioral Assessment of the Dysexecutive Syndrome Thames Valley Test Company. London[Google Scholar]. 1996.

22. Burgess PW, Alderman N, Evans J, Emslie H, Wilson BA. The ecological validity of tests of executive function. Journal of the international neuropsychological society. 1998;4(6):547-58.

23. Mooney B, Walmsley C, McFarland K. Factor analysis of the self-report Dysexecutive (DEX-S) Questionnaire. Applied Neuropsychology. 2006;13(1):12-8.

24. Wilson B, Alderman N, Burgess P, Emslie H, Evans J. BADS– DEX (Dysexecutive questionnaire). GB, London: Harcourt Assesment; 1996.

25. Heaton RK. Wisconsin card sorting test: computer version 2. Odessa: Psychological Assessment Resources. 1993.

26. MacLeod CM. Half a century of research on the Stroop effect: an integrative review. Psychological bulletin. 1991;109(2):163.

27. Krikorian R, Bartok J, Gay N. Tower of London procedure: a standard method and developmental data. Journal of Clinical and Experimental Neuropsychology. 1994;16(6):840-50.

28. Vakili MM, Jahangiri N. Content validity and reliability of the measurement tools in educational, behavioral, and health sciences research. Journal of Medical Education Development. 2018;10(28):106-18.

29. Wilson BA, Evans JJ, Alderman N, Burgess PW, Emslie H. Behavioural assessment of the dysexecutive syndrome. Methodology of frontal and executive function. 1997:239-50.

30. Bennett PC, Ong B, Ponsford J. Measuring executive dysfunction in an acute rehabilitation setting: Using the dysexecutive questionnaire (DEX). Journal of the International Neuropsychological Society. 2005;11(4):376-85.

31. Norris G, Tate RL. The Behavioural Assessment of the Dysexecutive Syndrome (BADS): Ecological, concurrent and construct validity. Neuropsychological rehabilitation. 2000;10(1):33-45.

32. Burgess P, Alderman N, Wilson B, Evans J, Emslie H. The dysexecutive questionnaire. Behavioural assessment of the dysexecutive syndrome Bury St Edmunds, UK: Thames Valley Test Company. 1996.

33. Wood RL, Liossi C. The ecological validity of executive tests in a severely brain injured sample. Archives of Clinical Neuropsychology. 2006;21(5):429-37.

34. Bennett PC, Ong B, Ponsford J. Assessment of executive dysfunction following traumatic brain injury: Comparison of the BADS with other clinical neuropsychological measures. Journal of the International Neuropsychological Society. 2005;11(05):606-13.

35. Stuss DT, Benson DF. The frontal lobes: Raven Pr; 1986.

36. Stuss DT, Gow CA, Hetherington CR. " No longer Gage": frontal lobe dysfunction and emotional changes. Journal of consulting and clinical psychology. 1992;60(3):349.

37. Shallice T, Burgess PW. Deficits in strategy application following frontal lobe damage in man. Brain. 1991;114(2):727-41.

38. Burgess PW. Theory and methodology in executive function research. Methodology of frontal and executive function. 1997:81-116.

39. Shinagawa Y, Nakaaki S, Hongo J, Murata Y, Sato J, Matsui T, et al. Reliability and validity of the Japanese version of the Dysexecutive Questionnaire (DEX) in Alzheimer's disease: validation of a behavioral rating scale to assess dysexecutive symptoms in Japanese patients with Alzheimer's disease. International journal of geriatric psychiatry. 2007;22(10):951-6.

40. Barker LA, Morton N, Morrison TG, McGuire BE. Inter-rater reliability of the Dysexecutive Questionnaire (DEX): comparative data from non-clinician respondents-all raters are not equal. Brain Injury. 2011;25(10):997-1004.