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Frontal acquired brain injury, substance abuse and their common psychological symptoms in the Iranian population

KOUROSH BANIHASHEMIAN[1], RAZIEH ETESAMI POUR[1], & MANSOUR MOAZZEN[2]

[1]*Payam-e-Nour University, Jahrom Branch, and* [2]*Payam-e-Nour University, Khavaran Branch, Iran*

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Abstract

Primary objective: To compare the scores from the Iranian version of the Frontal Systems Behavioral Scale (FSBS) with the norms collected for the American, English-speaking population and to examine the ability of the FSBS to discriminate between acquired brain injury and addiction.

Research design: Multivariate analysis of variance (MANOVA) and post hoc Bonferroni tests.

Methods and procedures: 120 subjects (41 patients with frontal acquired brain injury [FABI], 47 abstinent Substance Abusers (SA), and 32 healthy controls from the Iranian population) were selected. An Iranian version of the FSBS was administered to all participants.

Main outcomes and results: Patients with FABI and SA had higher scores than the control group on the FSBS total score; patients with FABI scored significantly higher than SA, and SA significantly higher than controls. While SA had greater subscales of executive dysfunction than controls, patients with FABI had higher scores than SA and the control group in the subscales of disinhibition, apathy, and executive dysfunction.

Conclusions: Two clinical samples of Iranian participants had detective behavioral problems associated with frontal systems dysfunction based on Iranian version of the FSBS, which makes this scale a useful instrument for the detection of behavioral problems.

Keywords: *Frontal brain injury, substance abuse, symptoms*

There is a wide spectrum of behavioral problems such as poor inhibition (e.g., impulsive responses, inappropriate social behaviors), apathy (e.g., loss of initiative, lack of energy and interest, reduced affective expression), and executive dysfunction (e.g., poor planning and working memory, cognitive inflexibility, and defective decision-making) in both patients with acquired frontal brain injury and individuals with substance abuse [1, 2]. These behavioral problems are associated with functional disruption of three functional and anatomical neural systems involving different sections of the frontal cortex and its projections to subcortical structures. Studies about neurological lesion have linked apathy symptoms to alterations in the anterior cingulated–thalamic system, whereas disinhibition problems have been associated with alterations in the orbito-frontal–thalamic system, and declines of executive functioning have been associated with alterations in the lateral prefrontal–thalamic system [3]. Several injury studies have indicated that there are cognitive–executive deficits after acquired brain

Correspondence: Kourosh Banihashemian, Iran-Jahrom-Azadegan Blv-Payam-e-Nour University. Tel: +989173148778. Fax: +987912230801. E-mail: kouroshcpsp@yahoo.com

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damage affecting frontal–subcortical systems [4]. Recent neuropsychological studies indicate that the neurocognitive declines observed in substance abusers are a result of the disruption of the same frontal–subcortical systems [5, 6].

The Frontal Systems Behavioral Scale is a self-report instrument that is designed to measure behavioral problems resulting from damage to the frontal neural systems and including subscales for disinhibition, apathy, and executive dysfunction [7]. The instrument's ability to detect and investigate behavioral problems associated with frontal dysfunction has been established in a variety of disorders, including multiple sclerosis, schizophrenia, cortical dementias (Alzheimer), subcortical dementias (Parkinson and Huntington), and substance abuse [8–11]. In addition, The FSBS has indicated significant ecological validity in terms of correlations with activities of daily living target symptoms for primary caregivers and measures of financial planning [5, 6, 12, 13]. This instrument shows moderate correlations with neuropsychological index of executive functioning such as verbal fluency tests, the trail making test, the Wisconsin card sorting test, and *n*-back, go/no-go, and continuous performance computer tasks [1, 10, 14].

In spite of increasing usefulness of the FSBS, there is still little research on specific populations with frontal dysfunction [15]. Another important limitation is that almost all previous studies have been conducted in English-speaking populations, thus there are limitations in the potential generalizability not only in the United States (due to its increasing Hispanic population) but also in non-English-speaking countries. This study is concerned with developing a valid translation of the FSBS and applying it to groups with acquired brain injury involving acquired frontal brain injury, abstinent substance abusers, and healthy participants all recruited from an Iranian sample. The aim of this study was (1) to compare the scores from the Iranian version of the FSBS with the norms collected for American, English-speaking population, and (2) to examine the ability of the FSBS to discriminate between two clinical populations (acquired brain injury and addiction) with putative frontal dysfunction, as compared to a group of healthy participants. In this study it is hypothesized that the scores from the Iranian version of the FSBS would be comparable to those from the American norms in the acquired frontal brain injury and control groups, whereas no norms are available for substance abusers. One study conducted in the United States showed that abstinent polysubstance abusers had significantly greater scores than normal controls across all the subscales of the FSBS [1, 14], but scores of polysubstance abusers were still lower than those previously reported for individuals with head injury [16]. Thus, it is hypothesized that across the different subscales of the FSBS, patients with acquired frontal brain injury would score significantly higher than healthy controls, with substance abusers' scores falling in the middle of these two groups.

Materials and Methods

Participants

A total of 120 volunteers participated, including (1) 41 patients with FABI (29 men, 12 women), aged 16–50 years old (mean = 29.13 ± 12.01) and 7–16 years of education (mean = 10.44 ± 3.09); (2) 47 abstinent substance abusers, (43 men, 4 women) aged 17–56 (mean = 30.08 ± 7.06) and 6–15 years of education (mean = 9.64 ± 2.61); and (3) 32 healthy controls (28 men, 4 women) aged 18–52 (mean = 32.14 ± 7.59) and 6–18 years of education (mean = 10.85 ± 2.39). All were part of the Iranian speak-speaking population in Tehran. Patients with FABI were participating in a Holistic Rehabilitation Program in the Tehran Neurology Professional Center. Criteria of selection for candidates were (1) having lesions primarily affecting the frontal cortex, (2) being in the chronic phase after acquired brain damage between 6 and 12 months (in this study, only individuals who had chronic problems with damage were selected, and the patients who had recovery before 6 months didn't enter in study), and (3) keeping basic skills to learn new information and independently perform activities of daily living. Individuals who had alterations of self-awareness were excluded from the research due to self-report by the assessment of awareness of disability that measures task-specific awareness and is used in conjunction with the Assessment of Motor and Process Skills. Its scoring ranged from 0¼ "the patient completely denies his/her disability" to 4¼ "the client has a completely realistic opinion of his/her disabilities," based on his or her performance of the assessment of awareness of disability tasks. Response scores were summed to produce a summed score for the seven questions, with sums ranging from 0 to 28. [17]. Individuals who had a score under 2¼ were excluded from research. The etiology of FABI included traumatic brain injury (81.1% of cases), vascular accident (15.2% of cases), and tumors and anoxia (2.6% of cases). All lesions were confirmed by computed tomography or MRI. Substance abusers were selected while they were following residential treatment in a therapeutic center in Tehran. All participants were abstinent for at least 15 days before assessment. Abstinent former users were included in this study for two reasons: (1) previous studies show that the FSBS

scores are elevated in retrospective assessments of the period of substance use but stabilize during abstinence [14]; (2) previous studies show that self-report is much more reliable during abstinence than during substance use [18]. To confirm abstinence, random urine testing was conducted during the course of the study. Thus, the determination of abstinence was based on both self-report and drug screens. The selected participants were polysubstance users of different substances, including opium, stimulants, heroin, hashish, and cocaine. This is important in that it is impossible to find pure drug users in treatment settings, except for alcohol abusers. Mean duration of substance abuse in these participants was 8.11 years (SD = 4.87), and the mean duration of abstinence was 16.91 weeks (SD = 23.58; range 2–48 weeks, with the majority of the sample falling in the 1–6 months abstinence period—middle term abstinence or early partial remission). The control participants were selected by means of advertising posters located in education centers such as colleges, parks, recreation centers, and in Tehran. The inclusion criteria for the participation of controls in the research were (1) not having abused substances currently or in the past (participants did not meet DSM-IV abuse criteria for any drugs); (2) absence of a history of learning disability or mental retardation; (3) not having neurological alterations, such as epilepsy, head injury with loss of consciousness, fetal alcoholic syndrome, or systemic disease in the CNS or psychiatric diagnosis; and (4) not being on any medications. These data were obtained through a semi-structured interview. All participants signed an informed consent form before inclusion in the study.

Instruments

FSBS-Iranian Adaptation [7] was adapted and reproduced with special permission from the editor. The scale contains 46 items that assess behavioral problems associated with frontal systems dysfunction. This scale is divided in three independent subscales: apathy, disinhibition, and executive dysfunction. In this study a self-report version of the scale was used because it was difficult to reach and involve in the study relatives or significant others. To endorse the reliability of self-report, those patients with FABI that have deficits of self-awareness were excluded. All participants with abstinent substance abuse were abstinent for at least 15 days before assessment because of reliability in the FSBS scores as has been previously demonstrated [18]. The FSBS was translated into Persian and backtranslated into English by individuals knowledgeable of both languages and the neuropsychological literature. Variations from the original scale were resolved by agreement of members of the research group. The final Iranian version was approved by the authors and by Psychological Assessment Resources after a careful revision by its own commission, composed by English and Iranian speakers. Internal consistency of this was adequate in this sample (Chronbach alpha = 0.84). Subscales also showed adequate internal consistency, with Chronbach alpha values of 0.79, 0.75, and 0.82 for apathy, disinhibition, and executive dysfunction, respectively.

Procedure

The Iranian version of the FSBS was individually administered to both sets of patients as a part of a broader neuropsychological assessment that was routinely conducted in their treatment centers. Healthy participants were also individually tested using the Iranian version of the FSBS. Each individual read, understood, and signed an informed consent prior to individually completing the test. SPSS software was used for statistical analyses.

Variables and Statistical Analysis

The dependent variables were the scores from three groups (FABI, substance abusers, and controls) on the three subscales of the Iranian adaptation of the Frontal Systems Behavioral: apathy, disinhibition, and executive dysfunction. To examine hypothesis 1, i.e., to compare the results obtained on the Iranian adaptation of the FSBS with the normative scores from the original version, four ANOVA were run, one for each subscale and one for the total score, comparing the control group of the present study with their equivalent group in the original standardization sample. Since most of the participants in the control group were men, we restricted our comparison to the male subgroups from our control group ($n = 28$) and from the equivalent group of the original sample ($n = 30$). To examine hypothesis 2, i.e., possible differences between groups on the extent of frontal systems dysfunction related problems, a multivariate analysis of variance (MANOVA) and post hoc Bonferroni tests on the scores of the three groups (FABI vs. substance abusers vs. controls) across the three subscales of the the FSBS–Iranian adaptation (apathy, disinhibition, and executive dysfunction) were conducted. Additionally, to examine possible differences between the groups on the total scores of the scale, a one-way ANOVA was run.

Results

At first, in preliminary analysis to examine possible differences between groups (FABI, substance

Table 1. Demographic data of participants.

	Substance abusers $N=47$	FABI patients $N=41$	Healthy volunteers $N=32$	F/χ^2
Age (mean ± SD)	30.08 ± 7.06	9.64 ± 2.61	32.14 ± 7.59	1.751
Education (mean ± SD)	29.13 ± 12.01	10.44 ± 3.09	10.85 ± 2.39	1.732
Gender (M–F)	91.48–8.52	70.74–29.26	87.50–12.50	8.98**

Note. M, male; F, female, $^{**}p < 0.01$, SD, standard deviation.

abusers and controls) on age and years of education, two one-way ANOVA were conducted and to examine possible differences between these groups on gender, a chi-square test (χ^2) was conducted. There were no significant differences between groups on age and education, but groups differed in gender composition; there were significantly more women in the FABI group, although substance abusers and controls were well matched. Therefore, Spearman bivariate correlation analysis was conducted to analyze the relationship between gender and the dependent variables (the Frontal Systems Behavioral subscales and total scores) for each of the three groups independently. Results indicated no significant correlations between gender and scores on FSBS. Thus, we did not include gender as a covariate in subsequent analyses (Table 1).

In examining hypothesis 1 (to compare the results obtained on the Iranian adaptation of the FSBS with the normative scores from the original version), the scores from male normal controls included in the published norms of the FSBS [7] were contrasted with the scores from male normal controls in our sample. Results showed significant differences between the two samples on the subscales of apathy and disinhibition, and also in the total score. For all measures, the Iranian sample scored lower than the original English-speaking sample (Table 2).

To enhance precise analysis of the statistical relevance of the findings, the size effects of the previous analyses were calculated using the Cohen's delta statistic. The results indicated that the differentiation between both control samples was of moderate size, ranging from 0.28 (for executive dysfunction) to 0.71 (for apathy) (Table 2).

In examining hypothesis 2 (to investigate group differences on severity of frontal alterations), results showed that there were significant differences between the groups on the three subscales of the the FSBS–Iranian adaptation and in the the FSBS–Iranian adaptation total score (Table 3). Post hoc pairwise tests for multiple comparisons (Bonferroni) indicated patients with the FABI scored significantly higher (i.e., greater impairment) than substance abusers and controls on disinhibition and apathy. For apathy, there were no differences between substance abusers and controls. For disinhibition, there was a trend for substance abusers to score higher than controls, but it did not reach statistical significance ($p = .07$).

For executive dysfunction, differences emerged between the three groups: patients with FABI had higher scores than the other two groups, and substance abusers had increased scores compared to controls. Finally, for the total scores of the FSBS–Iranian adaptation, significant differences emerged between the three groups, with the FABI patients scoring significantly above the other two groups, and substance abusers scoring significantly above healthy group (Table 3). A close inspection of the confidence intervals presented in Table 3 reveals no overlap between the scoring distributions of the three groups on the total scores of the FSBS–Iranian adaptation. Hence, the confidence intervals of the FABI group did not overlap with the other two groups in the subscales of executive dysfunction and apathy. For disinhibition, there was minimal overlap between the upper limit of the confidence intervals of substance abusers and the lower limit of the confidence intervals of patients with the FABI.

Discussion

This study is concerned with first assessment of behavioral alterations associated with frontal systems dysfunction using clinical and healthy groups in an Iranian-speaking population. Patients with the FABI indicated significantly elevated scores (greater impairment) relative to substance abusers and controls on the total score and the three subscales of the FSBS–Iranian adaptation: disinhibition, apathy, and executive dysfunction. These results suggest that the FSBS–Iranian adaptation is a useful instrument to measure and detect behavioral problems associated with frontal systems dysfunction in Iranian-speaking individuals. These results are in agreement with those of research indicating that the analysis of behavioral profiles may be as useful as the assessment of cognitive performance in

Table 2. Differences between the original American control sample and the Iranian sample (males only).

	Iranian controls (1) Mean ± SD	American controls (2) Mean ± SD	*F*	Cohen's delta (δ)
Apathy	25.05 ± 5.83	28.9 ± 4.6	7.39**	0.71
Disinhibition	26.40 ± 6.25	30.7 ± 5.60	4.85*	0.54
Executive dysfunction	32.91 ± 6.65	33.8 ± 5.3	1.01	0.28
Total	84.99 ± 16.50	93.6 ± 10.9	5.61*	0.59

Note. SD, standard deviation; *$p < 0.05$; **$p < 0.01$.

Table 3. Results on the frontal systems behavioral scale—Iranian adaptation for brain injured, substance abusers, and healthy controls.

	Substance abusers Mean (SD) [CI]	F-ABI patients Mean (SD) [CI]	Healthy controls Mean (SD) [CI]	Wilks-lambda (3,131)	*F* (2,132)	Bonferroni
Apathy	28.77 (7.96) [26.68–30,92]	38.03 (9.27) [36.81–41.25]	25.29 (5.59) [21.74–28.20]	12.38***	35.11***	FABI → (SA = HC)
Disinhibition	30.91 (7.3) [28.91–32.96]	35.27 (8.35) [31.98–35.97]	27.29 (6.29) [24.93–29.69]		9.79***	FABI → (SA = HC)
Executive Dysfunction	38.18 (10.52) [34.59–40.77]	48.81 (10.40) [45.72–50.86]	32.95 (6.47) [28.64–36.05]		31.81***	FABI → SA → –HC
Total	96 (21.93) [91.72–100.39]	122.76 (21,13) [114.95–128.19]	85.59 (16.61) [80.25–90.93]		35.82***	FABI → SA → –HC

Notes. SD, standard deviation; CI, confidence interval; FABI, frontal acquired brain injury; SA, substance abusers; HC, healthy controls; ***$p < 0.001$.

characterizing the neuropsychological deficits resulting from frontal–subcortical injury [8, 9]. Previous studies have indicated that the subscales of apathy and executive dysfunction are especially sensitive in determining neuropsychological profiles linked to diverse disorders such as cortical and subcortical dementias, mainly in Parkinson and Alzheimer disease. Furthermore, psychometric studies have indicated that the scores in the executive dysfunction and apathy subscales are robust in differentiating a variety of pathologies [8, 16].

The disinhibition subscale has indicated sensitivity in distiguishing different degrees of severity of cortical dementias and in the differential diagnosis of subcortical dementias, i.e., Huntington vs. Parkinson [19]. In addition, the disinhibition subscale is useful in the quantification of behavioral problems resulting from brain surgery in Parkinson disease. Furthermore, this subscale is linked to the severity of drug use in substance abusers, and with poorer adaptive functioning and positive symptoms in schizophrenia [20]. The fact that previous research has identified a relationship between drug use severity and the disinhibition dimension [10, 11] is somehow conflictive with the fact that in present study significant differences between substance abusers and controls were not found. However, it is important to consider that the disparity between the groups was marginally significant in the expected direction, showing a moderate effect size ($d = 0.45$). Another interpretation issue is that of the heterogeneity of the sample, which was composed of polysubstance abusers. However, this is a common limitation in the human substance use neuropsychology literature, because it is very unusual to find pure users of any substances. In addition, it is unlikely that polysubstance use may have diluted differences between groups, since this pattern has been related to more severe neuropsychological impairment [5]. The drug abuse group was significantly impaired in the executive dysfunction domain, supporting previous findings in a U.S. polysubstance abuser sample [1, 14].

The findings of this study have important implications in developing functionally oriented and ecologically useful rehabilitation strategies with Iranian-speaking clinical populations. Several studies have indicated that the FSBS scores have significant correlations with indices of basic and instrumental activities of daily living in patients with dementia of the Alzheimer type [12, 16, 21] as well as with levels of needs of primary caregivers of acquired brain injury patients [22]. Thus, individual item analysis of problem behaviors in this scale could help treatment interventions in both patients with FABI and substance abusers.

Relative to the Iranian sample of the scale [7], there are apparent differences suggesting the

influence of cultural factors [23]. The role of culture in executive functions is relevant as it relates to the understanding and measuring of a wide range of emotional and social behaviors that are often unique to different cultures. In the clinical samples, the patients with FABI scored approximately less than 0.1 standard deviations in the total scale and in the subscales of executive dysfunction and disinhibition when compared to the clinical samples of the United States. Similarly, for the apathy subscale, the scores of FABI group were approximately 0.2 standard deviations below the U.S. sample. In addition, scores of substance abusers in this sample were very similar to those obtained in a study of a U.S. sample of polysubstance abusers [1, 14]. Conversely, the Iranian healthy control participants in the present study exhibited significantly lower scores than those obtained from U.S. healthy subjects. However, these differences were of moderate size and their clinical relevance is questionable; they could just reflect fluctuations within cultural approach or adaptive personality. Altogether, our findings indicate that cultural factors are more influential for scores of healthy subjects than for those of clinical populations.

Certain limitations must be considered. First, the limitation in number of subjects made replication of the results necessary. Second, the subjects of this research were mainly males, with fewer women. Groups were not matched on composition of gender due to the fact that in this study the male/female proportion of substance abusers found in the therapeutic communities was maintained and the higher prevalence of males found in the rehabilitation program for FABI. This higher rate of males in both groups is consistent with that referred by the Iranian national statistics [24]. Nonetheless, correlations failed to indicate an association between gender and FABI scores, thus we do not believe this is a noticeable variable in explaining the present results.

Overall, the results of this study indicate that the Iranian version of the Frontal Behavioral Systems Scale, or the FSBS–Iranian adaptation, permits characterization of two types of clinical patients sharing frontal dysfunction: acquired brain injury and substance abusers, as well as between the clinical populations and a sample of healthy volunteers. It is important to understand that this adaptation was completed with Iranian speakers in Iran and that the total number of patients and clinical subgroups were limited. Therefore, an appropriate concern would be the development of more comprehensive norms for Latin American populations in future research. Professionals must be aware of this limitation when applying this research to the primary cultural groups represented in the United States. In the meantime, the present scale serves to better understand the potential behavioral disruption of Iranian individuals with damage to frontal systems and provides the foundation for the development of ecologically and functionally more appropriate intervention plans.

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