The Executive Interview as a Screening Test for Executive Dysfunction in Patients with Mild Dementia

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OBJECTIVES: To validate the Executive Interview (EXIT25) as a screening instrument for executive cognitive dysfunction in patients with mild dementia.

DESIGN: Validation using group comparison and correlation studies.

SETTING: The Copenhagen University Hospital Memory Clinic, a multidisciplinary outpatient clinic based in a neurological setting.

PARTICIPANTS: Thirty-three patients with mild dementia (MMSE score $\geq$20) and 30 healthy controls.

MEASUREMENTS: The EXIT25, a 25-item screening instrument for executive dysfunction, was administered to all participants. Global cognitive function was measured using the MMSE. Patients were evaluated using traditional neuropsychological tests for executive dysfunction (Wisconsin Card Sorting Test, Trail Making Part B, Stroop Test, verbal fluency, design fluency, and verbal abstraction). Changes in behavior and functional impairment in activities of daily living were assessed using the Frontal Behavioral Inventory (FBI) and the Disability Assessment for Dementia Scale.

RESULTS: EXIT25 scores were significantly higher in patients than in the healthy controls; MMSE scores could not account for the differences. Thirteen of the 25 items separated the two groups. EXIT25 was found to correlate significantly with the Stroop Test, the verbal fluency tests, and the FBI.

CONCLUSION: The EXIT25 is able to capture executive cognitive deficits not primarily related to the general level of intellectual reduction in patients with mild dementia. In clinical practice, the EXIT25 might be a valuable supplement to the MMSE. **J Am Geriatr Soc 53:1577–1581, 2005.**

Key words: EXIT25; executive function; cognitive screening; mild dementia

Executive functions can be described as a set of cognitive skills that are required for the planning, initiation, and regulation of complex goal-directed behavior. Neuroanatomically, executive functions are associated with the prefrontal cortex and its basal ganglia–thalamic connections.[1]

Most dementing illnesses involve some degree of executive impairment.[2] In patients with Alzheimer's disease, the severity has been associated with functional decline, need for care, and development of neuropsychiatric symptoms.[3–6] It is therefore unfortunate that two of the most-used assessment scales in dementia, the Mini-Mental State Examination (MMSE) and the cognitive section of the Alzheimer's Disease Assessment Scale, contain no measurement of executive function.

Assessment of executive function is typically performed using neuropsychological tests developed to measure specific aspects such as response inhibition (Stroop Color/Word Interference Test), set shifting (Wisconsin Card Sorting Test), divided attention (Trail Making Part B), and productivity and flexibility (fluency tests). Thus, traditional neuropsychological evaluation is time consuming and requires specially trained personnel, advanced test material, and a more formal setting.

With an increasing number of patients referred for diagnostic evaluation early in the course of dementia, there is an increasing need for easily administered screening tests with high predictability for diagnosis and functional disability. The Executive Interview (EXIT25) is a screening instrument developed for assessment of executive dyscontrol.[7] Clinicians (or other trained staff) can administer it in almost any setting, and it requires a maximum of 15 minutes Most studies using the EXIT25 have included broad populations of elderly subjects. These have shown that the EXIT25 discriminates elderly subjects with need for care or institutionalization from those without better than the MMSE.[7,8] Also, in noninstitutionalized older people, a decline in EXIT25 has been associated with decline in activity of daily living functions.[9] It could therefore be assumed that the EXIT25 would be useful as an executive screening instrument in early dementia.

The aim of this study was to validate the EXIT25 in a group of mildly demented patients. It was desired to investigate whether the EXIT25 was useful in discriminating

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mildly demented subjects from healthy controls and to examine the correlation between EXIT25 and a set of traditional neuropsychological tests for executive functions. In addition, it was desired to investigate whether the EXIT25 could be used as a predictor of behavioral changes and functional disability.

METHOD

Subjects

Thirty-three mildly demented patients were included. Patients were consecutively recruited from a prospective research program at the Copenhagen University Hospital Memory Clinic, an outpatient neurology clinic. The program included all newly referred patients aged 60 and older with a score of 20 or above on the MMSE. All patients underwent an extensive clinical assessment program including a neurological examination, psychiatric evaluation, neuropsychological assessment, laboratory screening, and magnetic resonance imaging and single photon emission computed tomography scans. Based on these investigations, a diagnostic classification was established. A total of 117 patients were included in this program. Eighty-five of these had completed the EXIT25.

For this study, only patients who had completed the EXIT25 and fulfilled the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,* criteria for dementia were included. Primary etiological diagnoses were Alzheimer's disease (n = 22, according to National Institute of Neurological Disorders and Stroke/Alzheimer Disease and Related Disorders Association criteria), vascular dementia (n = 4, according to the National Institute of Neurological Disorders and Stroke/Association Internationale pour la Recherche et l'Enseignement en Neurosciences criteria), mixed dementia (n = 4), frontotemporal dementia (n = 2, according to consensus criteria[10]), and unspecified dementia (n = 1). None of the patients had comorbidity believed to influence their cognitive functions (moderate or severe depression, other severe psychiatric illness, alcohol or drug abuse, major head injury, or former cerebrovascular episodes).

Healthy Controls

Thirty controls were selected from a cohort of 58 healthy elderly volunteers to match the patient group in age, education, and premorbid intelligence quotient (estimated using the Danish Adult Reading Test). All underwent a broad medical examination, a psychiatric screening using the Brief Psychiatric Rating Scale,[11] and a full neuropsychological battery. Persons with history of alcohol or drug abuse, severe psychiatric illness, former or present neurological disease, clearly impaired performance on memory tests, or interfering handicaps (e.g., problems hearing or seeing) were excluded.

Investigations

The EXIT25

The EXIT25 consists of 25 items or short tasks all described in the literature as reflecting frontal dysfunction.[7] The tasks are presented to the patient in rapid succession and with minimal instruction, which allows little time for reflection and therefore may enhance any tendency of disinhibition or inappropriate responses. Scores range from 0 to 50, with high scores indicating executive impairment. A score of 15 or higher is considered to be indicative of clinically significant executive impairment.[7]

Neuropsychological Tests for Executive Functions

Seven internationally well-known tests representing different aspects of executive functioning were administered to all subjects.

1. Trail Making Test Part B.[12] Time and errors were recorded. Ten patients failed to perform the test. For these, a maximum score of 500 seconds was assigned. Because of the large amount of missing data, it was decided not to analyze Trail B errors.
2. Stroop Color-Word Interference Test.[13] Time was recorded for the incongruent version of the test. A maximum score of 360 seconds was applied if the patient failed to complete the test.
3. Modified Wisconsin Card Sorting Test.[14] Number of errors were recorded. Nine patients refused or were unable to complete the test. Data from these patients were converted to a floor level score of 36 errors (chance level).
4. Category fluency. Number of different animals produced in 1 minute was recorded.
5. Lexical fluency. Number of different words beginning with the letter S was recorded.
6. Design fluency.[15] Number of different designs produced in 3 minutes was recorded.
7. Similarities (Wechsler Adult Intelligence Scale). Raw score was recorded.

Global Cognitive Evaluation

Global cognitive evaluation included the MMSE and the Danish Mental Status Test (DMST). The DMST is a battery consisting of 28 subtests, the majority being modifications of internationally well-known cognitive tests.[16] Tests are grouped into six cognitive domains: memory, attention, abstraction, language, visuoconstruction, and visual perception. Domain scores, corrected for age and education, are computed. A score less than -2.0 is considered to be a sign of impairment. Based on this, the patient's cognitive profile is determined. Of the seven executive tests, only the verbal fluency tests are included in the DMST. The level of premorbid intelligence was estimated using the Danish Adult Reading Test (a Danish version of the National Adult Reading Test).

Behavior Rating

Behavioral changes associated with frontal dysfunction were assessed using the Frontal Behavioral Inventory (FBI).[17] The FBI is a 24-item structured interview with the patient's caregiver covering behaviors such as apathy, indifference, inflexibility, perseveration, personal neglect, social inappropriateness, and aggression, as well as more-specific frontal lobe signs such as hyperorality, hypersexuality, and utilization behavior. An FBI score was obtained for 29 patients.

Functional Disability

The Disability Assessment for Dementia (DAD) scale was used as a measure of the functional limitations of the

patient's daily activities.[18] The scale consists of questions relating to basic self-care and instrumental activities of daily living. The score is obtained based on a caregiver interview. DAD scales were completed for 23 patients.

Procedure

The controls were given all neuropsychological tests in one session. For the patients, the same tester (JS) administered the EXIT25 at the same time as the DMST. Another neuropsychologist, blind to the results on the EXIT25, administered the additional executive tests on a second visit. These test results had no effect on the diagnosis. In most cases, the neuropsychologist doing the first testing scored the FBI because the patient typically brought a relative on the first visit. A neurologist administered the MMSE, and a specialist nurse administered the DAD scale. Both were unaware of the results of the EXIT25, the FBI, and the neuropsychological testing.

RESULTS

Patients and controls were matched on age, education, and estimated premorbid intelligence but differed significantly on all cognitive tests (Table 1).

Figure 1 shows the distribution of scores in the two groups. None of the healthy controls scored above 15 points. In the dementia group, the minimum score was 7 points, and the maximum score was 27. One-third of the patients scored 15 points or less, overlapping with the control group. The two patients with frontotemporal dementia scored 21 and 26 points, respectively, well above the group average.

The patients scored significantly higher than the controls on 12 of the 25 items, whereas the controls scored significantly higher than the patients on one item. The 13 items that separated the two groups are listed in Table 2. This list almost completely corresponds with the "top 12" list of items on which the patients obtained the highest scores. This reflects extremely low scores on the remaining items for controls and patients.

Within the patient group, a correlation (r) of -0.34 ($P = .06$) was found between the EXIT25 and the MMSE. Of the seven executive tests, only the Stroop Test ($r = 0.40$, $P = .03$), the category fluency test ($r = -0.43$, $P = .01$), and the lexical fluency test ($r = -0.54$, $P < .001$) were significantly correlated with the EXIT25. A mildly significant correlation between EXIT25 and the relatives' observation of behavioral changes as measured using the FBI was found ($r = 0.38$, $P = .04$), whereas no correlation between EXIT25 and disability in everyday functioning as reflected in the DAD score was found in this population of mildly demented patients.

DISCUSSION

This study sought to validate the EXIT25 as a measure of executive dysfunction in patients with mild dementia. It was found that that mildly demented patients scored significantly higher on the EXIT25 than healthy controls when matched for age, education, and premorbid intelligence quotient. A study using the EXIT25 in a population of elderly at various stages of dementia showed a strong correlation between the EXIT25 and the MMSE ($r = -0.85$), indicating that the EXIT25 is highly sensitive to the general level of cognitive decline.[7] In the current group of only mildly demented subjects, this correlation was considerately milder ($r = -0.34$, $P = .006$), supporting what the previous study found in several later publications on nondemented elderly—that the MMSE cannot explain all of the variance in EXIT25.

When analyzing the individual test items, it was found that only half of them were of relevance in this group of patients. The items that primarily contributed to the patients' higher scores were the EXIT variants of some of the most well-known frontal lobe tests (e.g., Trail Making B, Stroop, fluency tests, go/no-go tests, conflicting instructions, and Luria's hand sequencing). Thus, these short versions of the tasks are able to capture executive deficits even in patients with mild dementia. The fact that almost none of the subjects in this study scored points on tests of automatic behavior, primitive reflexes, imitation, or utilization behavior makes good sense because these signs are typically associated with prominent frontal lobe dysfunction.

Table 1. Demographic Data and Scores on Cognitive Tests

Characteristic	Healthy Controls	Patients
Male/female	11/19	16/17
Age, mean ± SD	73.5 ± 4.8	76.3 ± 6.2
Education, years, mean ± SD	11.3 ± 2.7	11.1 ± 2.6
Danish Adult Reading Test score, mean ± SD	32.1 ± 8.6	28.3 ± 10.7
Mini-Mental State Examination score, mean ± SD	29.2 ± 1.0	24.2 ± 2.1*
Executive Interview score, mean ± SD	8.4 ± 3.2	17.6 ± 4.6*
Trail Making B, time, mean ± SD	97.9 ± 35.8	319.8 ± 157.5*
Stroop, time, mean ± SD	144.1 ± 28.1	233.8 ± 71.0*
Wisconsin Card Sorting Test, errors, mean ± SD	16.8 ± 9.3	23.97 ± 10.2*
Category fluency, mean ± SD	21.3 ± 4.3	10.5 ± 4.0*
Lexical fluency, mean ± SD	13.6 ± 3.8	7.1 ± 3.2*
Design fluency, mean ± SD	23.7 ± 9.2	14.9 ± 6.4*
Similarities, mean ± SD	19.5 ± 3.2	15.5 ± 3.5*

* $P < .001$.
SD = standard deviation.

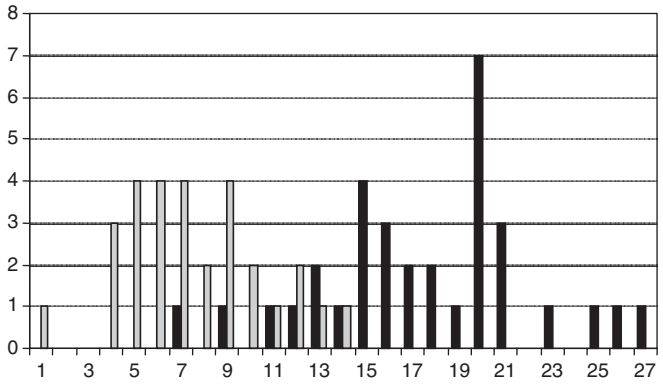

Figure 1. Distribution of Executive Interview (EXIT25) scores in patients and controls. *X*-axis: EXIT25 score; *y*-axis: number of subjects. Gray: control group; black: patient group.

Executive functions cover many different aspects of cognitive functioning, and there is no criterion standard executive measure. Evaluation of new instruments therefore involves investigating to what extent they correspond with already established measures. In this study, EXIT25 was found to correlate moderately with the Stroop Interference Test and the verbal fluency tests. Because these tests primarily are associated with left hemisphere functions,[19] this may be interpreted as supporting a previous study demonstrating correlation between EXIT25 and disease processes of the left frontal lobe.[19] From a cognitive point of view, the correlation with Stroop and verbal fluency can be interpreted as indicating that the EXIT25 is especially sensitive to failures in inhibition, initiation, and flexibility. In contrast the previous study,[7] no correlation was found between the EXIT25 and two of the most frequently used executive tests: the Wisconsin Card Sorting Test and the Trail Making Test Part B. This is probably a consequence of the more-homogeneous sample in the current study but might also reflect the sensitivity of these tests to nonexecutive cognitive functions.

A consistent finding in earlier studies is a strong predictive value of the EXIT25 with respect to the development of behavioral disturbances and functional decline.[7–9] Although behavioral disturbances were minimal in this group of mildly demented patients, a significant but mild correlation was found between the EXIT25 and the presence of behavioral symptoms. This suggests that the EXIT25 is sensitive to some cognitive aspects related to the development of behavior problems even in the early phases of dementia but also that no firm conclusions about the presence of aberrant behavior based on the EXIT25 can be made in mild dementia. No correlation was found between the EXIT25 and the level of functional disability measured as difficulties managing everyday activities such as dressing, shopping, and cooking, possibly because impairment in such tasks is modest in mild dementia.

Table 2. Executive Interview (EXIT25) Items Significantly Different in Patients and Controls

EXIT25 Item (Number and Task)	*P*-value
1. Number-letter task (Trail B)	<.01
2. Verbal fluency	<.01
3. Design fluency	<.01
6. Memory with distraction	<.01
7. Interference	<.05
12. Motor impersistence	<.05
14. Finger-nose-finger	<.01
15. Go/no-go	<.01
16. Conflicting instruction	<.01
17. Luria hand sequence 1	<.01
18. Luria hand sequence 2	<.01
20. Echopraxia 1 (clapping)*	<.05
22. Reversal task (months)	<.01

* The controls scored higher than the patients on this test.

The data resemble the data collected in the previous study,[7] which found that older people living essentially without help or services had an average EXIT25 score of 10.2, whereas elderly who lived by themselves but with need of services such as laundry, house cleaning, and meal preparation had an average score of 16.8. In the current group of healthy controls, the average score was 8.1, and in the group of mildly demented patients, it was 17.6. In addition, the suggested cutoff score of 15 points finds some support in the data from the current study, because none of the controls scored higher that 15 on the EXIT25.

The fact that the control group scored significantly higher than the patients on one of the tasks should be commented upon. In this task, the examiner suddenly claps his or her hands and registers whether the subject imitates this gesture, which is assumed to be a sign of echopraxia. The impression was that the control subjects' relatively high scores on this task reflected their attempt to determine what the examiner wanted them to do and had nothing to do with imitative behavior. The same phenomenon was observed in a similar task, in which the examiner, completely out of context, says "thank you" to elicit a conventional response. Quite a few of the subjects (controls and patients) obtained points here, responding "You're welcome" and looking somewhat bewildered. In fact, some subjects, including some in the high-functioning group, seemed uncertain, confused, and even astonished when presented with these portions of the EXIT25, and in a few cases, it was not administered to patients who were already hesitant about the standard neuropsychological examination, simply because it was feared that it might undermine cooperation.

As a screening test, the EXIT25 is long in its present form, which probably deters some clinicians from using it. According to this study, ambiguous or odd items such as handclap and "thank you" might safely be eliminated. Thus, a shorter version of the test might be preferred in most clinical settings.

In summary, the EXIT25 is able to capture executive cognitive not primarily related to general level of intellectual reduction (MMSE) in mildly demented patients, although only half of the EXIT25 items contribute significantly to the scores separating this group from healthy controls, indicating that more-prominent signs of frontal lobe dysfunctions are not present at this stage of dementia. Also, the test includes a few items that might cause confusion or even resistance in well-functioning patients. Despite these reservations, this study suggests that the EXIT25 can be a valuable supplement to the MMSE

when screening for cognitive deficits in mildly demented patients.

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