A Short Form of CNS Vital Signs for Use in Depression

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Introduction

Perceived problems with concentration, memory, problem solving, and thinking skills are a cardinal diagnostic feature of major depressive disorder (American Psychiatric Association, 1994, 2000). Clinicians frequently assess cognition informally, simply by interviewing the patient for subjective complaints. The effects of depression on formal neuropsychological testing can range from striking and extreme to virtually non-existent (Newman & Sweet, 1992). Zakzanis, Leach, and Kaplan (1998) conducted a meta-analysis and reported that reductions in memory, psychomotor speed, and sustained attention were the most prominent neurocognitive features of depression.

Neuropsychological testing in depression research typically involves traditional paper-pencil and manual-performance measures. Brief and comprehensive batteries have been used. Proper administration and scoring of neuropsychological tests requires a considerable amount of training and supervision. The use of computerized testing is an obvious advantage in this regard (e.g., Porter, Gallagher, Thompson, & Young, 2003; Sweeney, Kmiec, & Kupfer, 2000).

A co-normed computerized neurocognitive assessment battery, called the Central Nervous System (CNS) Vital Signs (Gualtieri & Johnson, 2006), appears to be appropriate for use with patients with depression (Gualtieri, Johnson, & Benedict, 2006). The CNS Vital Signs battery is normed across the lifespan for children, adolescents, and adults. It is presented at a grade four reading level. CNS Vital Signs is administered on a personal computer, uses the keyboard for participant responses, and it takes approximately 30-35 minutes to complete all measures. The results are summarized on a printout with raw scores, normative scores, percentiles, classifications, and test descriptions.

The purpose of this study is to illustrate a methodology for identifying neurocognitive impairment using a short form of the CNS Vital Signs computerized testing battery.

Methods

Participants

Adults with untreated depression were compared to 100 healthy control participants selected from the CNS Vital Signs normative database. Control participants were individually matched to the adult untreated depression sample on age [$t(198) = 0.08$, $p = .94$], education [$t(198) = 0.54$, $p = .59$], gender, and race. Demographic information regarding the patients and the control subjects is provided in Table 1. The matching procedure controls for variability in neurocognitive test performance that might result from differences in demographic variables.

Presented at the annual conference of the International Neuropsychological Society, February, 2008, Hawaii, USA.

Table 1. Demographic characteristics of the samples age, education, sex, and ethnicity.

	Depressed Sample	Matched Controls	t test (p value)
Mean Age	39.1	39.2	0.08 (0.94)
SD	12.5	11.8	---
Range	18-69	18-68	---
Mean Education	14.8	15.0	0.54 (0.59)
SD	2.4	2.3	---
Range	6-20	7-20	---
Male: Female	29:71	29:71	---
Caucasian: African American: Hispanic	89:9:2	89:9:2	---

Note: SD = Standard deviation. Degrees of freedom for t test was (198).

Measures

All participants completed CNS Vital Signs, a computerized assessment battery that takes approximately 30-35 minutes to administer. A short form of the battery, that takes approximately 10 minutes to complete, was derived utilizing only three of the seven tests: Finger Tapping, Stroop, and Shifting Attention. The Stroop Test and the Shifting Attention Test yield scores that are combined into two domain scores: Reaction Time and Cognitive Flexibility.

The *Finger Tapping Test* is a very simple test. Subjects are asked to press the Space Bar with their right index finger as many times as they can in 10 seconds. They do this once for practice, and then there are three test trials. The test is repeated with the left hand. The score is the average number of taps, right and left.

The *Stroop Test* uses four colors/color words (red, green, yellow, blue), and only one key is in play, the space bar. The test has three parts. In the first part, the words RED, YELLOW, BLUE, and GREEN (printed in black) appear at random on the screen, and the subject presses the space bar as soon as he or she sees the word. This generates a simple reaction time score. In the second part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. The subject is asked to press the space bar when the color of the word matches what the word says. This generates a complex reaction time score. In the third part, the words RED, YELLOW, BLUE, and GREEN appear on the screen, printed in color. The subject is asked to press the space bar when the color of the word does not match what the word says. This part also generates a complex reaction time score, called the "color-word reaction time." Part three also generates an error score.

The *Shifting Attention Test* (SAT) measures the subject's ability to shift from one instruction set to another quickly and accurately. In the SAT test, subjects are instructed to match geometric objects either by shape or by color. Three figures appear on the screen, one on top and two on the bottom. The top figure is either a square or a circle. The bottom figures are a square and a circle. The figures are either red or blue; the colors are mixed randomly. The subject is asked to match one of the bottom figures to the top figure. The rules change at random. For one presentation, the rule is to match the figures by shape, for another, by color. This goes on for 90 seconds. The goal is to make as many correct matches as one can in the time allotted. The scores generated by the SAT are: correct matches, errors, and response time in milliseconds.

Results

Patients with depression performed significantly more poorly than controls on the two domain scores (Cohen's d were d=.37 and .54, respectively). They also performed more poorly on all but one of the individual test scores (Cohen's d ranged from .35 to .70). These analyses, comparing the control and patient samples, are presented in Table 2.

Table 2. CNS Vital Signs test performance in depressed and matched control samples.

	Depressed Sample	Matched Controls	F test (p value)	Cohen's Effect Sizes (d)
Sample Sizes (n)	100	100	-	-
CNS Vital Signs Indexes				
Reaction Time Index (SD)	92.6 (28.1)	101.0 (17.4)	6.60 (.011)	0.37
Cognitive Flexibility Index (SD)	88.2 (28.9)	100.5 (16.8)	13.52 (<.001)	0.54
CNS Vital Signs Tests				
Finger Tapping (Right Hand)	52.1 (16.0)	58.1 (11.0)	9.65 (.002)	0.45
Finger Tapping (Left Hand)	49.4 (14.4)	56.5 (9.8)	16.81 (<.001)	0.59
Finger Tapping (Both Hands)	50.7 (14.6)	57.3 (10.0)	13.91 (<.001)	0.54
Stroop Simple Reaction Time (ms)	347.9 (214.9)	277.5 (64.2)	9.87 (.002)	0.50
Stroop Complex Reaction Time (ms)	633.7 (173.5)	566.2 (104.4)	11.10 (.001)	0.49
Stroop Commission Errors	2.1 (3.6)	0.5 (0.9)	18.13 (<.001)	0.70
SAT Correct	47.0 (14.6)	51.2 (9.1)	5.83 (.017)	0.35
SAT Errors	10.0 (12.0)	5.6 (5.5)	11.01 (.001)	0.50
SAT Correct Reaction Time (ms)	1036.6 (277.2)	1082.3 (179.1)	1.91 (.17)	0.20

Note: Degrees of freedom for ANOVAs was (1, 198). SAT = Shifting Attention Test.

When using one or more scores below the 5th percentile as the cutoff for neurocognitive impairment, 37% of the depressed sample and 12% of the control sample scored in this range [$\chi^2(1)=16.89$, $p<.001$; Odds Ratio=4.3, 95% CI=2.1–8.8]. When using one or more scores below 2SDs as the cutoff for impairment, 28% of the depressed sample and 8% of the control sample scored in this range [$\chi^2(1)=13.55$, $p<.001$; OR=4.5, 95% CI=2.0–10.2].

Table 3. Prevalence of low CNS VS domain scores in depressed and matched control.

Number of scores below cutoff	Patients with Depression		Matched Controls	
	%	C%	%	C%
< 1 SD				
2	19.0	19.0	6.0	6.0
1	24.0	43.0	14.0	20.0
0	57.0	100	80.0	100
< 10th %ile				
2	15.0	15.0	3.0	3.0
1	26.0	41.0	13.0	16.0
0	59.0	100	84.0	100
≤ 5th %ile				
2	11.0	11.0	1.0	1.0
1	26.0	37.0	11.0	12.0
0	63.0	100	88.0	100
< 2 SDs				
2	11.0	11.0	1.0	1.0
1	17.0	28.0	7.0	8.0
0	72.0	100	92.0	100

Note: % = percent; C% = cumulative percent.

Conclusions

This abbreviated computerized battery measures aspects of attention, speed of processing, and cognitive flexibility. A subset of patients with depression performed in the impaired range on this rapidly-administered short form. As seen in clinical practice, some unmedicated patients with depression have frank neurocognitive impairment.

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