Understanding Reported Cognitive Dysfunction in Older Adults With Cardiovascular Disease

Robert H. Paul  
*UMSL*, robert.paul@mimh.edu

John Gunstad

Ronald A. Cohen

David F.

Follow this and additional works at: [https://irl.umsl.edu/psychology-faculty](https://irl.umsl.edu/psychology-faculty)

Part of the Psychology Commons

**Recommended Citation**

Gunstad, J., Cohen, R. A., Paul, R. H., Tate, D. F., Hoth, K. F., & Poppas, A. (2006). Understanding Reported Cognitive Dysfunction in Older Adults With Cardiovascular Disease. Neuropsychiatric Disease and Treatment, 2(2), 213–218.

**Repository URL**

[https://irl.umsl.edu/psychology-faculty/19](https://irl.umsl.edu/psychology-faculty/19)
Understanding reported cognitive dysfunction in older adults with cardiovascular disease

John Gunstad1
Ronald A Cohen2
Robert H Paul2
David F Tate2
Karin F Hoth2
Athena Poppas3

1Department of Psychology, Kent State University, Kent OH, USA; 2Department of Psychiatry and Human Behavior, 3Department of Cardiology, Brown Medical School, Providence RI, USA

Abstract: Older adults with cardiovascular disease (CVD) often report experiencing significant cognitive dysfunction in everyday life and exhibit deficits on neuropsychological testing. However, the relationship between subjective and objective cognitive dysfunction is inconsistent across studies and requires closer examination. Participants included 84 older adults with documented CVD and no history of neurological or severe psychiatric disorder. All participants underwent echocardiogram and neuropsychological assessment and completed self-report measures of perceived cognitive dysfunction, depression, and health-related quality of life. Results showed that concerns regarding distractibility and sustained attention were most common. Level of reported cognitive dysfunction was significantly related to depressive symptoms, quality of life, and performance on multiple cognitive tests. Exploratory regression analyses showed that depressive symptoms, physical health-related quality of life, and speeded sustained attention predicted reports of cognitive dysfunction, whereas demographic variables, cardiac output, and other cognitive tests did not. Should they be replicated, these findings suggest that reports of cognitive dysfunction in older adults with CVD largely reflect depressive symptoms and reduced quality of life.

Keywords: cardiovascular disease, cognition, quality of life, depression

Introduction

There is growing evidence that cardiovascular disease (CVD) is a risk factor for cognitive dysfunction long prior to onset of stroke or dementia (Mazzucchi et al 1986; Kalra et al 1993; Grubb et al 1996; Elwood et al 2002; O’Reilly et al 2003; Trojano et al 2003). These findings are consistent with the notion of vascular cognitive impairment (VCI), a proposed continuum of cognitive deficits that ranges from “brain at risk” to vascular dementia (Hachinski and Bowler 1993; Bowler et al 1999). Older adults with CVD are believed to fall in the middle of this continuum, exhibiting cognitive deficits and cerebrovascular disease without the functional impairment found in dementia (Mazzucchi et al 1986; Kalra et al 1993; Grubb et al 1996; Elwood et al 2002; O’Reilly et al 2003; Trojano et al 2003; Cook et al 2004; Kuo and Lipsitz 2004).

Given these findings, it is not surprising that older adults with CVD often report experiencing significant cognitive dysfunction in everyday life (Khatri et al 1999). However, less straightforward is the fact that these reports are more closely related to depressive symptoms than objective test performance (Newman et al 1989; Khatri et al 1999; Bergh et al 2002). Such findings suggest that older CVD patients lack insight into their level of cognitive function. Reduced awareness of cognitive function is not unique to CVD patients and is found in persons with a variety of psychiatric and neurological conditions. For example, persons with bipolar disorder and patients in the early stages of dementia also exhibit little awareness of their impairments (Burdick et al 2000; Spitznagel and Tremont 2005).
However, methodological concerns of past studies encourage a re-examination of the relationship between subjective and objective cognitive impairment in CVD patients. Careful review shows that previous work often examined only cardiothoracic surgery patients, selected predictors from limited domains (ie, only cognitive and affective), and employed tests that tap cognitive abilities other than those patients report as being impaired (Newman et al 1989; Khatri et al 1999; Raja et al 2004). Each of these methodological choices may distort the observed relationship between reported cognitive dysfunction and test performance, raising the possibility that reports of cognitive dysfunction in CVD patients may not be as inaccurate as originally believed.

To clarify this possibility, the present study examined self-reported cognitive dysfunction in older adults with heterogeneous history of CVD. Variables were chosen to closely match those used in past studies and to extend the assessment of cognitive abilities that patients reported as being impaired. Using this method, we hypothesized that multiple factors, including cognitive performance, would be related to self-reported cognitive dysfunction of older adults with CVD.

Methods
The following methods were approved by the local Institutional Review Board prior to study onset.

Participants
Participants included 84 older adults enrolled in a prospective study of the neurocognitive consequences of CVD. They were required to have a documented history of CVD, a total score on the Mini Mental Status Examination (MMSE) above cutoff for dementia (Folstein et al 1975), and no history of neurological or severe psychiatric disorder. Participants were recruited from cardiology clinic patients and not selected based on concerns regarding possible cognitive dysfunction. Participants averaged 69.79 ± 7.87 years of age and 14.41 ± 2.72 years of education. Average MMSE score (28.52 ± 1.67) and cardiac ejection fraction (58.87 ± 11.65) were within normal ranges.

In terms of medical history, 46% of participants had a history of myocardial infarction, 37% coronary artery bypass, 11% valve repair or replacement, 13% heart failure, 74% hypertension, and 23% type 2 diabetes. Approximately 10% of participants had prior history of mild head injury, 9% transient ischemic attack, and 13% had history of depression.

Instrumentation
Subjective cognitive complaints
The Cognitive Difficulties Scale (CDS) is a pen-and-paper measure of subjective difficulties in attention, memory, perception, and psychomotor abilities (McNair and Kahn 1983). It has been used in both healthy and patient samples, including persons with CVD (McNair and Kahn 1983; Derouesne et al 1993; Derouesne et al 1999; Khatri et al 1999). The relationship among the CDS, depression, and cognitive function varies across studies. Although some studies show a strong relationship between the CDS and performance on neuropsychological tests, others find the CDS is more closely related to affective symptoms than cognitive dysfunction (Gass and Apple 1997; Derouesne et al 1999; Khatri et al 1999; Burdick et al 2005; Spitznagel and Tremont 2005).

Neuropsychological tests
All participants completed a neuropsychological test battery comprising tasks commonly used during clinical neuropsychological evaluation (Table 1). Domains included:
1) **Attention** (Trailmaking Test Part A [Reitan 1958], Digit Symbol-Coding [Wechsler 1997], Digit Span [Wechsler 1997], Stroop Color Word Test composite score for Word and Color trials [Golden 1978]);
2) **Executive function** (Trail Making Test B [Reitan 1958], Lexical Fluency [FAS; Eslinger et al 1984], Similarities [Wechsler 1997], Stroop Color Word Test Interference [Golden 1978]);
3) **Memory** (California Verbal Learning Test [Delis et al 1987], Brief Visuospatial Memory Test-Revised [Benedict 1997]);
4) **Language** (Boston Naming Test [Kaplan et al 1983], Category Fluency [Morris et al 1989]);
5) **Visuospatial skills** (Hooper Visual Organization Test [Hooper 1983], Block Design [Wechsler 1997];
6) **Motor function** (Grooved Pegboard Test for dominant and nondominant hand [Klove 1963]).

Depression
The Beck Depression Inventory (BDI) assesses vegetative, affective, and cognitive symptoms of depression and has been used extensively in patient populations (Beck and Steer 1993; Richter et al 1998).

Quality of life
The Medical Outcomes Study SF-36 (Ware et al 1994) is a measure of subjective health used extensively in healthy
and medical populations, including persons with CVD (Rumsfeld et al. 1999, 2001). Its eight domains were summarized into a Physical Composite Summary (PCS) and Mental Composite Summary scores (MCS), representing physical and mental quality of life, respectively.

Procedure After participants completed a written informed consent process, all instruments were administered in a one-to-one format by trained research team members. Participants completed self-report instruments after neuropsychological testing.

Data analysis Three sets of analyses were conducted to better understand the self-reported cognitive dysfunction of older adults with CVD. First, bivariate Pearson correlation was used to determine the relationship between reported difficulties on the CDS and objective test performance. An item analysis was then conducted to identify the cognitive abilities of greatest concern in our sample. Finally, exploratory regression analyses were conducted to determine the relative contribution of various factors to CDS total score. More specifically, we conducted multiple regression with backward elimination using CDS total score as the dependent variable. Predictors included demographic characteristics, measures of cardiovascular disease, depressive symptoms, quality of life, and performance on tests that tap the most commonly reported areas of dysfunction.

Results Test performance and reported cognitive dysfunction Participants typically performed well on neuropsychological testing, with their combined performance falling within 1.5 standard deviations of the normative mean on all tests (Table 1). Bivariate correlation showed that CDS total score was significantly related to depressive symptoms on the BDI, quality of life indices from the SF-36, and performance on multiple neuropsychological tests (Table 1).

Item analysis An item analysis was then conducted on the CDS. Corrected item-total correlations were used to identify the cognitive tasks of greatest concern to our sample of older adults with CVD. Results showed that difficulties with distractibility and sustained attention were most common, followed by language difficulties (Table 2).

Predicting reported cognitive dysfunction Finally, exploratory regression analyses were conducted to examine the relative contribution of various factors to the subjective cognitive difficulties of older adults with CVD. Stepwise regression with backward elimination showed significant prediction of CDS total score ($F[3, 56] = 13.31$,
The present findings highlight the complicated relationship among reported cognitive dysfunction, concerns of older CVD patients. Reduced attentional abilities may be expected in persons with CVD, as they often show reduced performances on neuropsychological tasks tapping attention, psychomotor speed, and executive function (Mazzucchi et al 1986; Kalra et al 1993; Grubb et al 1996; Elwood et al 2002; O’Reilly et al 2003; Trojano et al 2003). Language impairment is not traditionally associated with CVD in the absence of stroke, though word-finding difficulties are part of both the normal aging process and a symptom of Alzheimer’s disease (Mackay et al 2002; Testa et al 2004). Finding that language performance was within expected ranges implicates normal aging as a likely cause, but the very early effects of a neurodegenerative process cannot be fully ruled out. Prospective examination of our and other samples of CVD patients will help clarify whether reported word-finding difficulties predict later conversion to Alzheimer’s disease.

In the present study, reports of cognitive dysfunction were associated with reduced performance on multiple cognitive tests. However, the observed relationships were modest in size (range from –0.19 to –0.36) and explained little of the total variance. In contrast, depressive symptoms were closely related to reports of cognitive dysfunction (r = 0.55). Finding reported cognitive problems are more closely related to depressive symptoms than actual test performance is consistent with many past studies (Newman et al 1989; Khatri et al 1999; Raja et al 2004), though the exact reason for this relationship remains unclear. Several possible explanations for this finding exist, including shared method variance, the known effects of subclinical depression on cognitive performance, or an as yet unidentified factor (Wollert and Buchwald 1979).

Analyses also showed that quality of life contributes to the report of cognitive dysfunction in older adults with CVD. A relationship between quality of life and reported cognitive dysfunction has previously been found in healthy and other patient populations (Collins and Abeles 1996; Dijkstra et al 1998; Levy-Cushman and Abeles 1998). Physical illness is known to limit cognitive performance in several ways, including greater distraction, hypervigilance, and preoccupation during tasks (Luoto et al 1999; Gasquione 2000). These changes would adversely impact the same attentional abilities reported by our sample as being impaired. However, once again, the effects of shared method variance on this relationship cannot be fully excluded and replication in other samples is needed.

The present findings highlight the complicated relationship among reported cognitive dysfunction,

---

**Table 2** Most common subjective cognitive problems in older adults with cardiovascular disease

| Rank | Item | Corrected item-total correlation |
|------|------|---------------------------------|
| 1    | I cannot keep my mind on one thing. | 0.76 |
| 2    | I miss the point of what others are saying. | 0.75 |
| 3    | I have trouble getting out information that is at the tip of my tongue. | 0.71 |
| 4    | I find it hard to keep my mind on a task or job. | 0.70 |
| 5    | I find it hard to understand what I read. | 0.68 |
| 6    | I forget right away what people say to me. | 0.68 |
| 7    | I need to have instructions repeated several times. | 0.68 |
| 8    | I have trouble describing a program that I just watched on television. | 0.66 |
| 9    | When interrupted during reading, I have trouble finding my place again. | 0.66 |
| 10   | I have to do things very slowly to make sure I’m doing them right. | 0.65 |

---

**Table 3** Predicting cardiovascular disease (CVD) total score in older adults with CVD

| Included variables | B  | b  | p   |
|-------------------|----|----|-----|
| Beck Depression Inventory | 2.18 | 0.45 | <0.01 |
| Physical Quality of Life | –0.48 | –0.21 | 0.05 |
| Stroop Sustained Attention | –1.10 | –0.30 | <0.01 |
| Intercept | 92.80 |   | |

| Excluded variables | B  | p   |
|-------------------|----|-----|
| Age | 0.03 | 0.78 | 0.04 |
| Education | –0.12 | 0.26 | –0.15 |
| Cardiac Output | 0.12 | 0.27 | 0.15 |
| Mental Quality of Life | –0.19 | 0.16 | –0.19 |
| Digit Symbol-Coding | –0.04 | 0.77 | –0.04 |
| CVLT Trial I | –0.05 | 0.63 | –0.07 |
| FAS | 0.04 | 0.73 | 0.05 |
| Boston Naming Test | –0.13 | 0.22 | –0.17 |

Abbreviations: CVLT, California Verbal Learning Test.
depression, and actual test performance. Like many others, we found a weak relationship between reported cognitive dysfunction and actual test performance. This pattern emerged in our sample with intact test performance. Interestingly, reported cognitive dysfunction is also unrelated to actual test performance in Alzheimer’s patients and psychiatric samples with significant cognitive impairment (Burdick et al 2005; Spitznagel and Tremont 2005). This pattern suggests two likely explanations. One possibility is that people generally have little insight into their level of cognitive function. This inability may well result from the difficulty in accurately evaluating cognitive function in everyday life or the effects of limited executive functioning (which has been associated with reduced awareness in patient populations (Michon et al 1994; Singh-Manoux et al 2003; Kuo et al 2004). A second possible explanation involves the use of cross sectional methodology. It is possible that between-subject differences (eg, level of depressive symptoms) obscure more subtle within-subject changes (eg, reporting a slight change from previous levels). Prospective examination of reported cognitive dysfunction and actual test performance are much needed, particularly studies that collect detailed information regarding subjective change in cognitive function.

The present study has important implications for clinicians working with older adults with CVD. Based on the present findings, CVD patients reporting cognitive dysfunction are most appropriately referred for neuropsychological evaluation to determine the relative contribution of depressive symptoms, reduced quality of life, and actual cognitive impairment to these complaints. Clinicians may also want to consider additional referral to exercise or rehabilitation program, as they are associated with improved mood, quality of life, and cognitive performance in both healthy and patient populations (Barnes et al 2003; Stewart et al 2003; Gunstad et al 2005).

Acknowledgments
This study was supported in part by F32-HL74568 (JG), R01-AG017975 (RAC), and K23-MH065857 (RPH).

References
Barnes D, Yaffe K, Satariano W, et al. 2003. A longitudinal study of cardiorespiratory fitness and cognitive function in healthy older adults. J Am Geriatr Soc, 51:459–65.
Beck A, Steer R. 1993. Manual for the Beck Depression Inventory. San Antonio, TX: Psychological Corporation.
Benedict R. 1997. Brief Visuospatial Memory Test-Revised:Professional Manual. Odessa, FL: Psychological Assessment Resources.
Bergh C, Backstrom M, Jonsson H, et al. 2002. In the eye of both patient and spouse:memory is poor 1 to 2 years after coronary bypass and angioplasty. Ann Thorac Surg, 74:689–93.
Bowler J, Steenhuis R, Hachinski V. 1999. Conceptual background to vascular cognitive impairment. Alz Dis Assoc Dis, 13:530–7.
Burdick K, Endick C, Goldberg J. 2005. Assessing cognitive deficits in bipolar disorder: are self-reports valid? Psychiatry Res, 136:43–50.
Collins M, Abeles N. 1996. Subjective memory complaint in the able elderly. Clin Gerontol, 16:29–54.
Cook I, Leuchter A, Morgan M, et al. 2004. Longitudinal progression of subclinical structural brain disease in normal aging. Am J Geriatr Psychiatry, 12:190–200.
Delis D, Kramer J, Kaplan E, et al. 1987. Manual: California Verbal Learning Test, Adult Version. San Antonio, TX: Psychological Corporation.
Deroeux C, Dealberto M, Boyer P, et al. 1993. Empirical evaluation of the ‘Cognitive Difficulties Scale’ for assessment of memory complaints in general practice: A study of 1628 cognitively normal subjects aged 45–75 years. Int J Geriatr Psychiatry, 8:599–607.
Deroeux C, Thibault S, Lagha-Pierucci S, et al. 1999. Decreased awareness of cognitive deficits in patients with mild dementia of the Alzheimer type. Int J Geriatr Psychiatry, 14:1019–30.
Dijkstra J, Van Boxtel M, Houx P, et al. 1998. An operation under general anesthesia as a risk factor for age-related cognitive decline: Results from a large cross-sectional population study. J Am Geriatr Soc, 46:1258–65.
Elwood P, Pickering J, Bayer A, et al. 2002. Vascular disease and cognitive function in older men in the Caerphilly cohort. Age Ageing, 31:43–8.
Folstein M, Folstein S, McHugh P. 1975. Mini-mental state. J Psychiatr Res, 12:189–98.
Gasquoine P. 2000. Postconcussional symptoms in chronic back pain. Appl Neuropsychol, 7:83–89.
Glassman A, Shapiro P, Ford D, et al. 2003. Cardiovascular health and depression. J Psychiatr Pract, 9:409–21.
Golden C. 1978. Stroop color and word task: A manual for clinical and experimental uses. Wood Dale, IL: Stoeling.
Grubb N, O’Carroll R, Cobbe S, et al. 1996. Chronic memory impairment after cardiac arrest outside hospital. BMJ, 313:143–6.
Gass C, Apple C. 1997. Cognitive complaints in closed-head injury:relationship to memory test performance and emotional disturbance. J Clin Exp Neuropsychol, 19:290–9.
Gunstad J, MacGregor K, Paul R, et al. 2005. Cardiac rehabilitation improves cognitive performance in older adults with cardiovascular disease. J Cardiopulm Rehab, 25:173–6.
Hachinski V, Bowler J. 1993. Vascular dementia. Neurology, 43:2159–60.
Hooper, H. 1983. The Hooper Visual Organization Test. Los Angeles, CA: Western Psychological Services.
Kalra L, Jackson S, Swift C. 1993. Psychomotor performance in elderly hypertensive patients. J Hum Hyperten, 7:279–84.
Kaplan E, Goodglass H, Weintraub S. 1983. Boston Naming Test. Philadelphia, PA: Lea and Febiger.
Khatri P, Babyak M, Clancy C, et al. 1999. Perception of cognitive function in older adults following coronary artery bypass surgery. Health Psychol, 18:301–6.
Klove H. 1963. Clinical neuropsychology. In Forster FM (ed). The medical clinics of North America. New York, NY: Saunders.
Kuo H, Lipsitz L. 2004. Cerebral white matter changes and geriatric syndromes: is there a link? J Gerontol A Biol Sci Med Sci, 59:818–26.
Kuo H, Sorond F, Iloputaife I, et al. 2004. Effect of blood pressure on cognitive functions in elderly persons. J Gerontol A Biol Sci Med Sci, 59:1191–4.
Levy-Cushman J, Abeles N. 1998. Memory complaints in the able elderly. Clin Gerontol, 19:3–24.
Luoto S, Taimela S, Hurri H, et al. 1999. Mechanisms explaining the link between low back trouble and deficits in information processing:A controlled study with follow-up. Spine, 24:255–61.
Mackay A, Connor L, Albert M, et al. 2002. Noun and verb retrieval in healthy aging. *J Int Neuropsychol Soc*, 8:764–70.

Mazzucchi A, Mutti A, Poletti A, et al. 1986. Neuropsychological deficits in arterial hypertension. *Acta Neurol Scand*, 73:619–27.

McNair D, Kahn R. 1983. Self-assessment of cognitive deficits. In Ferris NS, Bartus R (eds). Assessment in geriatric psychopharmacology. Mark Powley. p 137–43.

Michon A, Deweer B, Pillon B, et al. 1994. Relation of anosognosia to frontal lobe dysfunction in Alzheimer’s disease. *J Neurol Neurosurg Psychiatry*, 57:805–9.

Morris J, Heyman A, Mohs R, et al. 1989. The consortium to establish a registry for Alzheimer’s Disease CERAD. Part 1. Clinical and neuropsychological assessment of Alzheimer’s disease. *Neurology*, 39:1159–65.

Newman S, Klinger L, Venn G, et al. 1989. Subjective reports of cognition in relation to assessed cognitive performance following coronary artery bypass surgery. *J Psychosom Res*, 33:227–33.

O’Reilly S, Grubb N, O’Carroll R. 2003. In-hospital cardiac arrest leads to chronic memory impairment. *Resuscitation*, 58:73–9.

Raja P, Blumenthal J, Doraishwamy P. 2004. Cognitive deficits following coronary artery bypass grafting: prevalence, prognosis, and therapeutic strategies. *CNS Spectr*, 9:763–72.

Reitan R. 1958. Validity of the Trail Making Test as an indicator of organic brain damage. *Percept Mot Skills*, 8:271–6.

Richter P, Werner J, Heerlein A, et al. 1998. On the validity of the Beck Depression Inventory: a review. *Psychopathology*, 31:160–8.

Rumsfeld J, Magid D, O’Brien M, et al. 2001. Changes in health-related quality of life following coronary artery bypass graft surgery. *Ann Thorac Surg*, 72:2026–32.

Rumsfeld J, MaWhinney S, McCarthy M, et al. 1999. Health-related quality of life as a predictor of mortality following coronary artery bypass graft surgery. *JAMA*, 281:1298–303.

Singh-Manoux A, Britton A, Marmot M. 2003. Vascular disease and cognition function: evidence from the Whitehall II Study. *J Am Geriatr Soc*, 51:1445–450.

Spitznagel M, Tremont G. 2005. Cognitive reserve and anosognosia in questionable and mild dementia. *Arch Clin Neuropsychol*, 20:505–15.

Stewart K, Turner K, Bacher A, et al. 2003. Are fitness, activity, and fatness associated with health-related quality of life and mood in older persons? *J Cardiopulm Rehab*, 23:115–21.

Testa J, Ivnik R, Boeve B, et al. 2004. Confrontation naming does not add incremental diagnostic utility in MCI and Alzheimer’s disease. *J Int Neuropsychol Soc*, 10:504–12.

Trojano L, Antonelli Incalzi R, Acanfora D, et al. 2003. Cognitive impairment: a key feature of congestive heart failure in the elderly. *J Neurol*, 250:1456–63.

Ware J, Kosinski M, Keller S. 1994. SF-36 Physical and Mental Health Summary Scales: a user’s manual, 2nd ed. Boston, MA: The Health Institute, New England Medical Center.

Wechsler D. 1997. Manual for the Wechsler Adult Intelligence Scale. 3rd ed. San Antonio, TX: The Psychological Corporation.

Wollert R, Buchwald W. 1979. Subclinical depression and performance expectations, evaluations of performance, and actual performance. *J Nerv Ment Dis*, 167:237–42.