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Healthcare Resource Use among Heart Failure Patients in a Randomized Pilot Study of a Cognitive Training Intervention

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Abstract

Objectives—To compare healthcare resource use of patients with heart failure (HF) randomized to the cognitive training intervention and to the health education active control intervention in a randomized controlled pilot study.

Background—Cognitive training interventions may be efficacious and improve patients' memory and abilities to perform instrumental activities of daily living and self-care behaviors that may, in turn, lower healthcare resource use, but the influence of these interventions on healthcare resource use is unknown.

Methods—Thirty-four HF patients were randomized to the computerized plasticity-based cognitive training intervention called Brain Fitness and to the health education active control intervention and completed the study. The primary outcome variable for the study was memory (recall and delayed recall). The secondary purpose of the study that is the focus of this paper was to compare healthcare resource use between the two groups using the third-party payer perspective. Data were collected at baseline and at 8 and 12 weeks after baseline. Healthcare resources were priced at Medicare payment levels for services and average wholesale price for medications.

Results—Average costs of visits, procedures, and medications were similar between groups. Average costs of hospitalizations and tests, and therefore total costs, were half as much in the Brain Fitness group as compared to the active control group, but this difference was not significantly different from zero ($p = .24$).

Conclusions—Larger randomized controlled trials are needed that include analyses of program costs and costs associated with medical and non-medical services in order to fully evaluate efficacy of this intervention.

Keywords

cognition; healthcare resource use; heart failure; memory; cost

Introduction

Heart failure (HF) continues to be a major public health problem. In the United States, 5.1 million Americans have HF and estimates are that by 2030, prevalence will increase by 25%.¹ The burden of HF is staggering - mortality, healthcare resource use, cost of care, and patient suffering are high. Despite many new therapies, in 2008 the risk-adjusted twelve-month mortality rate following hospitalization was 29.6%.² Healthcare resource use has continued to increase and costs are projected to double by 2020.³ In 2004, HF was the primary reason for one million hospitalizations and the primary or secondary reason for 3.6 million hospitalizations.⁴ Heart failure is the leading reason for rehospitalizations among older adults^{5,6} with 50% of HF patients rehospitalized within six months of hospital discharge.⁷ In 2006, there were 3,390,000 ambulatory care visits for HF.⁸ At \$39 billion for 5.7 million patients, costs currently average \$7,000 per year. Among 765 patients, lifetime medical care costs after HF diagnosis were \$109,541, and the majority of costs were

attributable to hospitalizations (mean \$83,980).⁹ Among 1,075 older adults who had 1,435 hospitalizations, mean total hospitalization cost was \$18,086 (SD \$26,736; median \$10,454; range from \$762 to \$544,797).¹⁰

One possible factor that may contribute to high healthcare resource use among HF patients is cognitive dysfunction. Cognitive dysfunction is prevalent among HF patients with 23 to 50% of patients having decreased attention, memory loss, psychomotor slowing, and decreased executive function.^{11–13} Cognitive dysfunction in HF may be associated with poor compliance with medications and dietary sodium restrictions that are known to be associated with increased hospitalizations in HF.^{14,15} Although few studies have specifically investigated the associations between cognitive dysfunction and increased healthcare resource use among HF patients, it has been investigated in other populations of older adults. For example, among patients with Alzheimer or other dementias Medicare expenditures are three times higher than for older patients without Alzheimer or other dementias and Medicaid payments are 19 times higher.¹⁶ Surprisingly, caregivers of patients with mild cognitive impairment (n = 25) reported as many needs for support services as caregivers of patients with moderate Alzheimer disease (n = 55).¹⁷ Therefore, efficacious interventions that improve cognitive function and prevent or delay memory loss might lower healthcare resource use by improving compliance with therapeutic regimens and performance of instrumental activities of daily living.

Cognitive training interventions hold tremendous promise for improving cognitive function (e.g., memory, working memory, psychomotor speed, reasoning, executive function) and lowering healthcare resource use among older adults, including those with chronic conditions such as HF. In the Advanced Cognitive Training for Independent and Vital Elderly (ACTIVE) trial of face-to-face cognitive training interventions (10 sessions over 5–6 weeks) among 2,832 healthy older adults,¹⁸ 87% of participants who received the interventions had improved psychomotor speed, 74% had improved reasoning, and 26% had improved memory immediately after the interventions and improvements were sustained for two and five years.¹⁹ Among the group trained in reasoning, annual predicted healthcare expenditures declined by \$223 (p = .024) at one year after training.²⁰

In a computerized memory training intervention tested among 182 adults age 60 and older,²¹ adults who completed the intervention (n = 62) had improved memory (p = .019) compared with adults in the attention (n = 61) and no-contact (n = 59) control groups.²¹ In a multisite randomized controlled double-blind trial, the computerized intervention Brain Fitness (PositScience) was tested among 487 community-dwelling older adults without cognitive impairment.²² Improved memory and attention were significantly greater (p = .02) in the group who received memory training (3.9 points, 95% CI = 2.7 – 5.1) than in the active control group (1.8 points, 95% CI 0.6 – 3.0), with the magnitude of the effect sizes suggesting results were clinically meaningful.²²

Brain Fitness was selected as the cognitive training program for testing in a randomized controlled pilot study among patients with HF²³ because it was developed based on scientific principles of neuroplasticity and was efficacious in community-dwelling older adults without cognitive impairment.²² The overall purpose in the pilot study was to test the efficacy of a nurse enhanced computerized memory training program, Brain Fitness, to improve the primary outcome of memory (recall and delayed recall) among patients with chronic HF. Forty HF patients were randomized to the Brain Fitness cognitive training intervention and the health education active control intervention; 34 patients completed the 12-week study. Patients who did not complete the study had poorer baseline scores on measures of memory (p = .025) than patients who did complete it.²³ Patients in both groups received weekly home visits for 8 weeks from advanced practice nurses (APNs) to monitor

compliance with the interventions and evaluate patients' physical health during intervention delivery. Patients in both the Brain Fitness and active control groups had significant improvement over 12 weeks in recall memory ($p < .001$). Compared with patients in the active control group, only patients in the Brain Fitness group had significant improvement over 12 weeks in delayed recall memory ($p = .032$).

The secondary purpose of the randomized controlled pilot study²³ that is the focus of this paper was to compare healthcare resource use between patients randomized to the two groups. In an era of increasingly constrained resources, healthcare resource use was collected as part of this pilot study to begin to understand the potential economic benefits of the Brain Fitness intervention. Determining resources and costs of new interventions is becoming increasingly essential prior to widespread testing and implementation.²⁴

Methods

Design

The 2-group randomized controlled pilot study was approved by the university institutional review board. All patients provided written informed consent prior to participation. Healthcare resource use was compared between patients randomized to Brain Fitness and the health education active control interventions who completed the study using the third-party payer perspective.

Procedures

Investigators collected data from April 2008 to July 2010. Five data collectors were trained to collect data using face-to-face interviews (three were APNs enrolled in a PhD program, one registered nurse enrolled in a master's nursing program, and one clinical psychologist). Data were collected at baseline to describe the demographic and clinical status of patients. Data for the outcome variables were completed at baseline and at 8 and 12 weeks after initiation of the interventions by face-to-face interviews. Patients received incentive fees for completion of baseline (\$25), 8 (\$25), and 12 (\$50) week data collection. Healthcare resource use data were collected from the medical records after the 12-week outcomes data were collected. Study procedures and results have been described in more detail elsewhere.²³

A blocked randomization procedure was used. Randomization assignments were placed in envelopes that were opened sequentially after baseline data collection when each patient was randomly assigned to the Brain Fitness intervention or the health education active control intervention. Given the small number of patients, the randomization was not stratified on any other variable and the block size was a consistent 2 that assures very close to equal numbers of patients per group in small samples.

Sample

Patients were recruited from a HF clinic with a multidisciplinary staff affiliated with a tertiary care university medical center located in the Midwestern United States. The inclusion criteria were: 1) adults aged 21 years and older; 2) can understand English; 3) telephone access; 4) able to hear normal conversation as determined by the research team member; 5) can see and read a computer screen; 6) current diagnosis of chronic systolic HF verified by echocardiography or other diagnostic tests within the past two years;²⁵ 7) New York Heart Association (NYHA) class 2, 3, or 4; and 8) optimized medical therapy as recommended by national guidelines.^{26,27} Patients were excluded if they had: 1) history of MI or new onset cardiomyopathy within the past 6 months; 2) history of major drug or alcohol abuse; 3) major psychiatric condition (e.g., schizophrenia); 4) central nervous

system disorder or degenerative disease (e.g., Alzheimer or other dementias, Parkinson's, stroke); 5) encephalopathy; 6) chronic kidney disease requiring dialysis; 7) congenital heart disorder; 8) terminal cancer; or 9) prisoner status.

To recruit patients, the cardiologist or clinical study coordinator at the clinic site reviewed weekly schedules of all patient appointments and screened patients to identify whether they met the eligibility criteria. If patients met the criteria, they were invited to participate by the cardiologist or clinical study coordinator. Names and contact information of interested patients were provided to members of the research team who then contacted patients by telephone and explained the study in more detail. If patients agreed to participate, a visit was scheduled to obtain informed consent and collect baseline data.

Interventions

The cognitive training program, Brain Fitness, was developed by PositScience based on scientific principles of neuroplasticity. Specifically, Brain Fitness was designed to increase integration of sensory information because the ability to learn and remember new information is closely associated with the ability to hear and accurately interpret auditory information. Brain Fitness is a series of exercises designed to improve a person's ability to hear speech, refine listening skills, and improve the ability to encode, recall, and use information. The program incorporates surprising and novel content in the stories that is unexpected because this type of content engages patients' attention and is more easily remembered.^{21,28–31}

The program is computerized to deliver content that is individualized to the person's baseline ability and that increases in complexity as performance improves. To deliver the intervention, laptop computers with 14-inch monitor screens were placed in patients' homes. Noise-canceling headphones were provided. All patients received instruction to use Brain Fitness during the first home visit. They were requested to use the program 1 hour a day, 5 days a week, for 8 weeks (total 40 hours).

The health education active control intervention was designed to provide general health-related information relevant to cardiovascular disease (e.g., symptoms of myocardial infarction, heart healthy diets). Each week, patients were given a new issue of the magazine *Heart Insight*.³² This magazine is a high-quality consumer-oriented magazine published by the American Heart Association and Lippincott Williams and Wilkins. Patients were asked to read 1 issue every week for at least 1 hour for 8 weeks (total 8 hours).

The Brain Fitness and the health education active control interventions were delivered over eight weeks, during which time APNs from the research team made weekly home visits to assess HF-related physical symptoms, discuss problems or concerns about the interventions, and monitor intervention adherence. The APN home visits were included because data from past studies indicated that HF patients had weekly changes in symptoms³³ and other factors³⁴ that limited their ability to comply with home-based interventions and APNs effectively manage HF symptoms.³⁵ The home visits by APNs assisted in monitoring intervention fidelity and troubleshooting problems with delivery of this novel cognitive training intervention. The home visits lasted approximately 20 to 30 minutes each.

Measures

Demographic and clinical data—Demographic and clinical data were obtained from the medical records and during the baseline interviews. We measured patients' HF-related health status (i.e., Duke Activity Status Index³⁶ and the Living with Heart Failure Questionnaire Physical Subscale³⁷), comorbid conditions (Charlson Comorbidity Index³⁸),

and global cognitive function (Mini-Mental State Examination³⁹) to provide a more complete description of the patients' status, compare baseline equivalencies among the groups, and allow for comparison with HF samples in the literature. Satisfactory validity and reliability among HF patients have been reported for the Duke Activity Status Index (Cronbach alpha = 0.82, n = 249 HF patients⁴⁰) and the Minnesota Living with Heart Failure Questionnaire Physical Subscale (Cronbach alpha = 0.94, n = 211 HF patients⁴¹). Satisfactory inter-rater reliability and predictive validity of the Charlson Comorbidity Index have been demonstrated among 3,496 primary care patients.^{38,42} Satisfactory validity and reliability among older adults have been widely reported for the Mini-Mental State Examination^{39,43} and it was a predictor of 12-month mortality among 166 HF patients ($p = .004$).⁴⁴

Healthcare resource use—At 12 weeks, healthcare resource use data were collected from the electronic medical record system at the study site by members of the research team (SJP, JG) using a structured data abstraction form. The form was developed by one of the investigators (DGS) to document patients' visits and telephone calls to providers, hospitalizations, procedures, laboratory tests, and medications. The APN home visits and phone calls for scheduling research home visits and data collection visits were not included in resource use because it was part of the research study. Costs for services using the healthcare resource data were computed at Medicare national average payment levels for 2012 (diagnosis related group acute inpatient fee schedule, resource-based relative value scale physician fee schedule, ambulatory payment classification outpatient fee schedule and Medicare clinical laboratory fee schedule) (<http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/FeeScheduleGenInfo/index.html>) and costs for medications were computed using average wholesale prices (Red Book, Ann Arbor, MI: Thomson Reuters, 2011). All costs are presented as \$US for 2012.

Statistical analyses

Descriptive statistics (means, standard deviations, medians, frequencies, t-tests, and chi-square) were computed to describe the sample and compare baseline equivalencies and healthcare resource use between the groups. Healthcare resource use data were categorized as follows: 1) provider visits, contacts, and hospitalizations; 2) diagnostic procedures; 3) laboratory tests; and 4) medications. Medications were grouped by categories because of the large numbers of medications prescribed. Only data collected at the study site were available. Wilcoxon rank-sum test and analysis of variance between groups was used to test the statistical significance of cost differences between Brain Fitness and control groups. Significance level was set at $p < .05$. SPSS was used to describe the sample and compare baseline equivalencies and group differences. .

Results

Demographic and clinical data for the 34 patients who comprise the study sample are presented in Table 1. No significant differences were found between patients randomized to the Brain Fitness and health education active control groups who completed the study except patients in the control group had more physical symptoms ($p = .026$) at baseline compared with patients randomized to the Brain Fitness group.

Twelve week healthcare resource use findings are presented in Table 2. Patients assigned to the active control group had more appointments at the cardiology and device clinics, with nurses, and at other types of clinics than patients in the Brain Fitness group. All of the patients in the Brain Fitness group had nurse telephone calls while only four patients in the control group used this service. Over twelve weeks, six patients were hospitalized one time

(three patients in the Brain Fitness group and three patients in the control group) and three patients were hospitalized two times (one in the Brain Fitness group and two in the control group). Number and type of diagnostic procedures received were similar for both groups. Three patients in the Brain Fitness group and one in the control group had a cardiac catheterization during the twelve weeks. Patients in the Brain Fitness group had a total of 60 different laboratory tests and patients in the control group had 83 different tests. The most frequently obtained laboratory tests were complete blood count (Brain Fitness = 6; active control = 9), estimated glomerular filtration rate (Brain Fitness = 7; control = 8), brain natriuretic peptide (Brain Fitness = 4; control = 6), and basic metabolic panel (Brain Fitness = 6; control = 8).

The numbers of prescribed medications by category are presented in Table 3. The most commonly prescribed categories for the Brain Fitness group were vitamins and supplements, beta-adrenergic blocking agents, angiotensin-converting enzyme inhibitors and angiotensin-receptor blocking agents, statins and other lipid lowering agents diuretics, aldosterone antagonists, gout management medications, and other medications. The most commonly prescribed categories for the control group were vitamins and supplements, statins and other lipid lowering agents, angiotensin-converting enzyme inhibitors and angiotensin-receptor blocking agents, beta-adrenergic blocking agents, diuretics, and anti-anginal medications.

Costs (resource units multiplied by payment amounts) are presented in Table 4. Total costs ranged from \$778 for a patient using only prescription medications to \$60,113 for a patient hospitalized twice during the 12-week study. Average costs of visits, procedures, and medications were similar between groups. Average costs of hospitalizations and tests, and therefore total costs, were half as much in the Brain Fitness group as compared to the control group. None of the cost differences was significantly different from zero.

Discussion

To our knowledge, this is the first study examining healthcare resource use of HF patients who completed a cognitive training intervention. In this sample, total costs were half as much in the Brain Fitness group as compared to the active control group, but the difference was not significantly different from zero. The findings support the expectation that patients with HF require a substantial number of healthcare resources to manage their illness. Consistent with past studies, patients in both groups had high resource use over twelve weeks.⁴⁵ High resource use was seen with the number of patients who had hospitalizations ($n = 9$) and cardiac catheterizations ($n = 4$) over twelve weeks supporting the seriousness and complexity of HF in this sample. Nonetheless, patients completed the cognitive training intervention and demonstrated improvement in memory.²³ Patients in the Brain Fitness group had fewer total provider visits and hospitalizations and fewer diagnostic and laboratory tests, but they also had fewer physical symptoms at baseline; sample size prevented statistically testing for differences between the groups. At a 5% significance level and 80% power, the observed difference in means (\$3,908) and standard deviation of costs (\$10,512) suggest a need for a sample size of 230 patients. The ability of the Brain Fitness intervention to improve memory and reduce healthcare resource use needs to be tested in a larger randomized controlled trial with a longer follow-up time. Evidence from the ACTIVE trial suggests that cognitive training effects can be sustained over time,¹⁹ are associated with lower healthcare expenditures,²⁰ and are associated with a 50% lower rate of motor vehicle collisions, defined as per-person mile, six years after training.⁴⁶

The weekly visits by APNs to patients in both groups of the study were included because of the substantial data supporting the benefits of nurse-managed care for HF patients.⁴⁷ The purpose of the APN visits was to strengthen and monitor patient compliance with the

interventions and to evaluate patients' physical health during intervention delivery. It is possible that the APN visits influenced the intervention and resource use. Weekly visits added to the overall cost of the administration of the study and the way the visits influenced healthcare resource use was not evaluated. Wolinsky and colleagues⁴⁸ reported that cognitive training interventions delivered to older adults in the home without other support were equally efficacious when compared with interventions delivered in a controlled clinical environment. Previously, Koelling and colleagues⁴⁹ reported results of a randomized controlled trial ($n = 223$ HF patients) in which a brief one hour face-to-face educational intervention delivered by a nurse educator lowered risk of death and rehospitalization ($p = .018$) and reduced cost of care by \$2,823 per patient ($p = .035$) 180 days after baseline. Thus, it is possible that less intense evaluations such as weekly phone calls may be sufficient to enhance cognitive training interventions in HF, but this strategy has not been tested. Further studies are needed to evaluate the type and amount of weekly APN support needed for cognitive training. A larger trial would allow a more thorough evaluation of healthcare resource use. Possible reasons for lowered healthcare resource use resulting from improved memory, such as increased compliance with medications and dietary sodium restrictions, and better performance of instrumental activities of daily living and self-care behaviors, need to be incorporated in the design of future trials.

This study had limitations with respect to evaluation of healthcare resource use. First, the sample was small and recruited from one academic medical center. Patients in the sample were relatively young (mean age = 57.3) compared with the general population of HF patients and results may not be generalizable to older HF patients. Future studies are needed among larger samples of patients from multiple sites.

Second, patients randomized to the control intervention had worse physical symptoms at baseline than patients randomized to Brain Fitness and this may have influenced healthcare resource use. However, there were no other differences at baseline between the groups in the measured demographic and clinical variables. In a larger study, patients could be stratified by physical symptoms to more thoroughly evaluate resource use. Third, only healthcare resource use from the study site was included in this analysis; resource use from other sites was not collected. Fourth, data from the medical records included either a generic name or a brand name and therefore, costs were obtained that were associated with that generic or brand name. In practice, patients may have been prescribed a brand name medication, but only the generic name was recorded in the medical record. Alternatively, and perhaps more commonly, a generic name would have been provided at the pharmacy even if a brand name medication was prescribed (with or without a dispense as written order). Again, this was a limitation of using medical records as opposed to payment records. Fifth, inter-rater reliability of data obtained from the medical records was not assessed. Although structured data abstraction forms were used to improve reliability of the data retrieved, use of a valid, reliable questionnaire for healthcare resource use such as that described by Smaldone and colleagues⁵⁰ may improve data quality. Finally, the follow-up of the study was 12 weeks. A longer follow-up time with booster interventions is needed to fully evaluate resource use.

In summary, patients who completed the Brain Fitness cognitive training intervention had total healthcare costs that were half as much as the active control group although these differences were not significant. The 34 patients enrolled in the study had high healthcare resource use. A larger randomized controlled study that includes cost-effectiveness analysis is needed to fully evaluate the Brain Fitness intervention and its influence on healthcare resource use. Larger studies are needed that: 1) include a more diverse sample of older adults with HF recruited from multiple sites; 2) stratify patients by physical symptoms; 3) evaluate type and amount of APN support needed to support intervention adherence; and 4) determine whether improvements in memory are associated with reduced healthcare

resource use because of better compliance and improved performance of instrumental activities of daily living and self-care behaviors. If Brain Fitness is efficacious in a larger study, future studies would be warranted that examine potential neural mechanisms underlying improvement.

Although cognitive dysfunction is prevalent among HF patients, no evidence-based interventions are available for clinicians to recommend. At the present time, clinicians can assess patients for cognitive dysfunction and on an individual basis, teach patients and family members ways to compensate for cognitive dysfunction. For example, providing both verbal and written instructions about medication and dietary regimens may be helpful to patients with memory loss. Providing verbal instructions in quiet environments free of noise and distractions may be helpful to patients with difficulty in attention and concentration. Including family caregivers when teaching patients about symptom management may improve monitoring for fluid volume excess (e.g., weight gain, edema). Ultimately, interventions that improve cognitive function and lower healthcare resource use could be incorporated into guidelines to improve patient outcomes.

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Table 1

Demographic and clinical variables (n = 34)

Characteristic	Total (n=34)	Brain Fitness (n=17)	Health Education (n=17)	P-value
Age, mean $\pm$ SD ^a	57.3 $\pm$ 12.4	53.9 $\pm$ 12.1	60.7 $\pm$ 12.1	.110
Sex, n (%)				.452
Men	24 (71)	11 (65)	13 (76)	
Women	10 (29)	6 (35)	4 (24)	
Race, n (%)				.888
African-American	5 (15)	3 (18)	2 (12)	
Asian	2 (6)	1 (6)	1 (6)	
White	27 (79)	13 (76)	14 (82)	
Ethnicity, n (%)				.545
Hispanic	3 (9)	2 (12)	1 (6)	
Non-Hispanic	31 (91)	15 (88)	16 (94)	
Education, yrs, mean $\pm$ SD	13.9 $\pm$ 2.0	13.5 $\pm$ 1.8	14.3 $\pm$ 2.2	.242
LVEF ^b , mean $\pm$ SD	25.6 $\pm$ 9.8	27.0 $\pm$ 8.6	24.3 $\pm$ 11.0	.435
NYHA ^c class, n (%)				.638
I	10 (29)	6 (35)	4 (24)	
II	16 (47)	8 (47)	8 (47)	
III	8 (24)	3 (18)	5 (29)	
Duke Activity Status Index, mean $\pm$ SD	22.8 $\pm$ 16.8	27.0 $\pm$ 15.5	18.6 $\pm$ 17.4	.147
LHFQ ^d	8.9 $\pm$ 7.4	6.1 $\pm$ 5.5	11.6 $\pm$ 8.2	.026*
Physical Subscale				
Charlson	2.1 $\pm$ 1.0	1.9 $\pm$ 0.9	2.4 $\pm$ 1.2	.190
Comorbidity Index, mean $\pm$ SD				
MMSE ^e	28.3 $\pm$ 1.4	28.5 $\pm$ 1.2	28.1 $\pm$ 1.5	.538
mean $\pm$ SD				
Implantable Cardioverter Defibrillator, n (%)	21 (62)	12 (71)	9 (53)	.290
Cardiac Resynchronization Therapy, n (%)				
Dual-Chamber	2 (6)	0 (0)	2 (12)	.145
Pacemaker, n (%)				
Left Ventricular Assist Device, n	1 (3)	1 (6)	0 (0)	.31

Characteristic	Total (n=34)	Brain Fitness (n=17)	Health Education (n=17)	P-value
(%)				

SD^a = Standard Deviation;

LVEF^b = Left Ventricular Ejection Fraction;

NYHA^c = New York Heart Association;

LHFQ^d = Living with HF Physical Subscale Questionnaire;

MMSE^e = Mini-mental Status Exam

Table 2

Twelve week healthcare resource use (n = 34)

Variable	Total	Brain Fitness (n=17)	Control (n = 17)
VISITS AND HOSPITALIZATIONS			
Cardiology clinic	15	5	10
Device clinic	12	8	4
Device calls	9	2	7
Hospital to home bridge clinic	2	0	2
Home health services	1	0	1
Other clinics	19	6	13
Nurse clinic visit	2	0	2
Nurse phone call	21	17	4
Nurse phone note	25	13	12
Phone call of lab results	4	0	4
Phone medication management	6	1	5
Physician phone note	3	0	3
Emergency department	2	0	2
1 hospitalization	6	3	3
2 hospitalizations	3	1	2
Total Visits and Hospitalizations	130	56	74
DIAGNOSTIC PROCEDURES			
Echocardiogram	7	3	4
Electrocardiogram	11	6	5
Chest x-ray	5	1	4
Other x-ray	2	1	1
Pulmonary function test	1	0	1
Ultrasound	1	0	1
Upper gastrointestinal test	1	0	1
Cardiac catheterization	4	3	1
Positron emission tomography	1	1	0
Computerized tomography of head	1	0	1
Total Procedures	37	16	21
LABORATORY TESTS			
Total Laboratory Tests	143	60	83

Table 3

Number of patients on prescribed medications by category (n = 34)

Medication Category	Brain Fitness (n = 17) Number	Control (n = 17) Number
Analgesics	4	3
Anticonvulsants	1	3
Antihistamines	2	1
Cardiovascular medications		
Angiotensin-converting enzyme inhibitor/Angiotensin II receptor blocking agent	14	16
Aldosterone antagonist	9	7
Antianginal	7	8
Antiarrhythmic	1	2
Antithrombotic	6	7
Beta-adrenergic blocking agent	15	16
Calcium-channel blocking agent	1	2
Statin/other lipid-lowering	14	20
Digoxin	6	3
Diuretic	13	13
Antidiabetic agents	5	7
Gastroesophageal reflux management	5	7
Gout management	9	2
Immunosuppressants	3	1
Pulmonary medications	2	2
Psychotropics, antidepressants	9	6
Vitamins, electrolytes, dietary supplements	16	21
Other	12	6
Total	167	163

Table 4

Costs of services type (2012US\$) (n = 34) (means, with ranges in parentheses)

Cost Category	Brain Fitness (n = 17)	Control (n = 17)	P-value
Average cost of visits	300.19 (0 – 1,034)	348.65 (0 – 1,183)	.43
Average cost of hospitalizations	1,196.60 (0 – 7,074)	4,726.30 (0 – 58,595)	.73
Average costs of procedures	911.67 (0 – 5,393)	768.18 (0 – 7,394)	.68
Average costs of tests	76.74 (0 – 300)	142.05 (0 – 811)	.65
Average costs of medications	1,336.06 (395 – 2,837)	1,744.52 (370 – 3,797)	.23
Average total costs	3,821.26 (778 – 14,171)	7,729.70 (1,584 – 60,113)	.24