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Efficacy of a Cognitive Training Program for Individuals with Moderate Cognitive Impairment: Evaluating Cognition

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Running head: COGNITIVE TRAINING FOR DEMENTIA

Efficacy of a cognitive training program for individuals with moderate cognitive impairment: Evaluating cognition

By

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COGNITIVE TRAINING FOR DEMENTIA

Efficacy of a cognitive training program for individuals with moderate cognitive impairment: Evaluating cognition

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COGNITIVE TRAINING FOR DEMENTIA

Efficacy of a cognitive training program for individuals with moderate cognitive impairment: Evaluating cognition

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Abstract

The purpose of the current study was to evaluate the efficacy of a cognitive training program among those with moderate cognitive impairment. A total of 23 individuals participated in the study and were randomly assigned to a wait-list control group or a cognitive training program that consisted of 24 cognitive classes for a total of 12 weeks. The cognitive training classes aimed to activate the six primary cognitive domains impacted with dementia, reaction time, attention, memory, language, visual-spatial skills, and executive functioning. All participants were evaluated with a battery of neurocognitive assessments pre-and post-treatment. The findings tentatively support the use of a structured cognitive training program for individuals with moderate dementia. Specifically, the cognitive areas that improved among those who received the cognitive training classes included verbal and visual memory recognition, learning, simple attention, complex attention, executive functioning, and visual memory recall. Furthermore the treatment group showed stabilization between pre- and post-treatment in general cognitive functioning, visuospatial skills, and verbal memory. The implications of the current study gives further support for the use of a cognitive training intervention for individuals with moderate stage dementia.

COGNITIVE TRAINING FOR DEMENTIA

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Introduction

As one ages, various cognitive abilities decline. Some of this decline is age-associated, meaning that it is relatively normative across older adults. However, cognitive decline may become severe enough that it negatively impacts an individual's ability to complete daily tasks (e.g., self-care) and may threaten one's independence and safety. How to slow or reverse cognitive decline is an area of great interest and many commercially available cognitive training products are available that claim to achieve this goal. Unfortunately, these claims are often unsubstantiated. In addition, most efforts to slow or prevent cognitive decline are aimed at relatively healthy older adults who are not yet experiencing significant cognitive decline. Much less attention has been paid to the development of cognitive training programs that target individuals who are already experiencing cognitive deficits. The following sections will describe normal and pathological cognitive decline that occurs with aging as well as review the empirical literature on cognitive training as it has been applied to those experiencing cognitive deficits.

Age-Associated Cognitive Decline

Specifically, the cognitive abilities that are most impacted as one ages includes processing speed, attention, and some forms of memory (Salthouse, 1996; Whitourne & Whitbourne, 2011). These functions do decline in older populations, and do not necessarily indicate the presence of a neurocognitive disorder. Information processing speed and general cognitive abilities slow as one ages; therefore, older individuals are

unable to comprehend and respond to stimuli as fast as their younger counterparts (Kramer & Madden, 2008; Salthouse, 1996; Craik & Salthouse, 2008). With normal aging, individuals become less efficient in attention processes including maintaining attention, switching attention, and multitasking (Kramer & Madden, 2008). Furthermore, attention and information processing can impact memory.

Memory processes, including episodic, source, recall, and prospective memory abilities, decline with age. Episodic memory includes encoding and retrieving information, source memory is the ability to recognize and remember sources of memory, recall memory is being able to recall past information, whereas prospective memory is the ability to know what will be taken place in the future or what tasks need to be completed (Craik & Salthouse, 2008).

There are certain memory functions that do not normally decline with age, and if declines in these functions occur, it is of concern and could indicate a cognitive disorder. Semantic memory, the memory of word meanings and factual information; procedural memory, physical or performance memory; implicit memory, information that is recalled without effort; recognition memory, the ability to remember information upon a cue; and autobiographical memory, memory of prominent or important events in one's past are all forms of memory remain intact with normal aging (Whitourne & Whitbourne, 2011).

Language abilities remain relatively stable as one ages; however, aspects of language may decline. Language may be impacted due to the decline in certain memory functions and other cognitive abilities. With normal aging, individuals often experience hearing loss and possibly the loss of speech abilities, which in turn may impact

communication abilities (Craik & Salthouse, 2008). Other functions that decline in normal aging can in turn impact language abilities. Therefore, healthy older adults may experience a decrease in reading speed, slower cognitive functioning, difficulty in retrieving memories including word meanings, deficits in working memory, and the decrease in complicated sentence structure (Whitourne & Whitbourne, 2011). However, further language impairment is indicative of problematic cognitive decline and possibly a neurological disorder.

Cognitive Decline without Dementia

Cognitive decline that does not meet diagnostic criteria neurological disorder, but is beyond what is found in healthy older adults, is referred to as cognitive decline without dementia (Plassman et al., 2008). Plassman and colleagues (2008) define cognitive impairment without dementia as a mild cognitive or functional impairment that is reported and noticed by others in the individuals' lives, but does not meet the criteria necessary for a diagnosis of dementia. Cognitive impairment without dementia impacts individuals' quality of life and increases neuropsychiatric symptoms (e.g., depression), disability, and health care costs (Lyketsos, 2002).

A large nationally representative study of individuals aged 71 or older, found the prevalence of cognitive decline without dementia is more prominent than dementia, impacting at least 5.4 million people aged 71 or older in the United States (Plassman et al., 2008). Furthermore, this study indicates that 22.2% of the older adult population is impacted with prodromal Alzheimer disease (8.2%) and cerebrovascular disease (5.7%). In fact, cognitive impairment without reaching the threshold of dementia increases the

risk for developing dementia. About 12% of individuals every year who have cognitive impairment without dementia progress to dementia, while only 1 to 2.5% of healthy adults progress to dementia. Annually 8% of individuals with cognitive impairment without dementia die. Due to the potentially progressive nature of cognitive impairment without dementia, interventions to stabilize this progression or decrease the impact of cognitive impairment are needed.

Dementia

Dementia is a general term for diseases that cause cognitive and memory decline. This progressive disease affects individuals' lives, from relationships (Meiland, 2005), activities of daily functioning (Luck, 2011), mood, and quality of life (Arrighi, McLaughlin, & Leibman, 2010). In fact, dementia is defined as interfering with social and or occupational functioning (Chertkow, Feldman, Jacova, Massoud, 2013).

Dementia impacts six cognitive domains (Chertkow et al., 2013). The Diagnostic and Statistical Manual (DSM), describes these domains in the diagnosis of a neurocognitive disorder, a category under which dementia is included (American Psychiatric Association, 2013). The DSM specifies that a neurocognitive disorder require evidence of significant or moderate cognitive decline from previous functioning in one or more cognitive domains (American Psychiatric Association, 2013). The diagnosis of dementia is similar to a neurocognitive disorder; however, dementia impacts two cognitive or behavioral domains (Chertkow, et al., 2013). The National Institute of Aging/Alzheimer's Association (NIA-AA) working groups identified the clinical criteria for dementia (McKhann et al., 2011). The decline associated with dementia must

interfere with daily functioning impacting the individual's independence, represent a decline from prior functioning, involve decline that is not due to another disorder, and is detectable with history and assessments of individual or from an informant. The cognitive impairments must involve two behavioral or cognitive domains (Chertkow, et al., 2013). The DSM identifies severity, for each cognitive domain an individual can have major or mild impairments (American Psychiatric Association, 2013). Mild or major impairment within each domain is assessed by the extent of impairment.

As identified by the American Psychiatric Association (2013), the first cognitive domain that is progressively impacted with dementia is complex attention. Complex attention includes sustained attention, which is the ability to maintain attention over time; selective attention, the ability to avoid distracting stimuli; divided attention, the ability to attend to two tasks; and processing speed, the amount of time an individual takes to think or understand information and stimuli. Complex attention deficits can lead to an individual having difficulty with multiple stimuli, difficulty holding new information and taking longer in processing information and completing tasks.

The second cognitive domain, executive function, includes planning, decision-making, working memory, feedback or error utilization, overriding habits and inhibition, and mental/cognitive flexibility. With deficits in executive functioning an individual may have difficulty completing tasks, multitasking, and making decisions.

The third cognitive domain impacted with dementia is learning and memory. Learning and memory includes immediate memory span, the ability to remember and hold information such as lists or digits; recent memory, such as encoding new

information; and long-term memory, including semantic, autobiographical and implicit learning. An individual with deficits in learning and memory may have difficulty in remembering recent event, frequently repeat self in conversation, and lose or misplace items.

The fourth domain is language. Language includes expressive language, such as naming and identifying items; grammar and syntax, such as omission or incorrect use of language; and receptive language, which is comprehension of written and verbal information and understand commands.

The fifth domain is perceptual-motor skills. This domain includes visual perception, such as facial recognition and identification; visuoconstructional, such as hand-eye coordination; perceptual-motor such as incorporating perception and movement or action; praxis, which is the ability to use and understand learned movements and gestures; and gnosis, which is the integrity of stimuli perception such as faces and items. An individual with deficits in this domain may get lost frequently, have difficulty in using tools, and may experience more confusion at dusk.

The sixth and final cognitive domain impacted from dementia is social cognition. Social cognition includes recognizing emotions, the ability to identify various types of facial emotional states; and theory of mind, which is the ability to empathize and understand or consider others emotions and experiences. Individuals with deficits in this area may show changes in personality or attitude. An individual may not recognize social cues and may act in socially inappropriate ways.

There are various causes of dementia including Alzheimer's disease (AD), vascular cognitive disorder, Lewy body disease, and frontotemporal lobar degeneration. AD is the most prevalent cause of dementia, impacting an estimated 5.3 million individuals in the United States (Alzheimer's Association, 2015). Furthermore, it is estimated that in 2025, 7.1 million Americans will have AD, with 14% of individuals aged 71 and older with a form of dementia (Alzheimer's Association, 2015).

Interventions for Cognitive Decline

Currently, there are limited intervention options for individuals experiencing cognitive decline that is beyond what is normally expected as part of the aging process. Some pharmacological interventions have been developed and used for individuals who have cognitive decline or dementia. Cholinesterase inhibitors, including donepezil, galantamine, and rivastigmine, are used to treat some of the symptoms associated with cognitive decline (Alzheimer's Association). These medications work by slowing down the breakdown of cholinesterase, an important neurotransmitter that production decreases with dementia progression. This drug becomes less effective in treating symptoms with prolonged use, and does not help reverse or stop the progression of the disease. N-methyl-D- aspartate receptor antagonist, or memantine, is another drug that is used for treating symptoms of dementia. Memantine works by regulating glutamate activity. Glutamate is a neurotransmitter that is involved in memory and learning. When this neurotransmitter is activated calcium is released, activating the cells in the brain. Individuals with dementia have overactive glutamate, which can lead to damaging cells with excess calcium exposure. This drug acts to protect the cells against the

neurotoxicity of excess glutamate for individuals in the moderate to severe stages of dementia. (Alzheimer's Association, n.d.)

Unfortunately, available medications are only effective for about six to 12 months (Alzheimer's Association, n.d.). The current drugs available are also only efficacious for about half of the individuals who undergo pharmacological treatments for dementia (Alzheimer's Association, n.d.). Therefore, there is a need of non-pharmacological interventions and preventions for individuals who have dementia. The question that remains is what can be done non-medically; currently there are a few options.

Non-pharmacological interventions. There is limited research addressing non-pharmacological interventions for dementia. It has been found that with the right amount of support and stimulation, individuals with dementia still have the ability to learn and retain some information (Backman, 1992, 1996; Bird, 2002). The possibility of cognitive stimulation being beneficial was first illustrated with reality orientation interventions (Woods, 2002). Reality orientation aims to improve quality of life by increasing orientation to current surroundings and to decrease confusion for individuals with dementia (Spector, Woods, & Orrell, 2000). Other psychological interventions for dementia include cognitive stimulation, cognitive training, and cognitive rehabilitation; these are often referred in literature interchangeably, however there are important conceptual and applied differences (Clare & Woods, 2004).

Cognitive rehabilitation aims to help individuals with dementia to maintain or achieve their optimal levels of functioning in terms of their physical, psychological, and social functioning (Clare & Woods, 2004). In doing so, individuals are encouraged and

supported to participate in desired activities and in concordance with their values. This form of intervention is individualized to meet the level of impairment and the client's goals, with a focus of improving daily life functioning. Cognitive rehabilitation includes making the most of the memory abilities that are still intact as well as utilizing ways to compensate for difficulties such as using memory aids (Clare & Woods, 2004).

Clare et al (2010) evaluated cognitive rehabilitation among sixty-nine individuals in the early stages of Alzheimer's disease. A randomized control trial was used to compare cognitive rehabilitation with relaxation therapy. The cognitive rehabilitation involved eight weekly individual sessions to address individualized goals, using aids and strategies for learning new information. The intervention also incorporated attention and stress management skills. To assess the intervention, the researchers evaluated satisfaction and goal performance and found that those in the cognitive rehabilitation had an increase in outcome measures than compared to those in the relaxation therapy. This study supports the use of general techniques to improve the quality of life of individuals with early stage dementia. A more specifically direct intervention may improve cognitive functioning.

Cognitive stimulation aims to improve cognitive and social functioning through general cognitive stimulation. This general stimulation approach is used due to the interconnection of cognitive functioning and memory. This approach is done in a group setting and involves activities and discussions (Clare & Woods, 2004)

There is a small body of empirical literature supporting the use of cognitive stimulation interventions. Spector et al (2003) conducted a randomized control trial of

201 participants assigned to receive cognitive stimulation or continued with normal daily activities. The cognitive stimulation was a 14-session program that ran twice a week that involved reality orientation as well as cognitive stimulation. The sessions involved a range of activities including a reality orientation board, to orient the participants to surroundings, current events, and some personal information. Other activities involved using money, memory games, and face-name association with famous faces. The participants were assessed for quality of life, cognition, depression, and behaviors. The treatment group had higher scores on cognitive measures and quality of life than the control group.

Quayhagen and Quayhagen (2001) also investigated cognitive stimulation among individuals with dementia Alzheimer's type and their caregivers. The participants were randomized into an experimental, control, or placebo group. Assessment data was collected pre (baseline) and post intervention (after 12 weeks). For one hour daily for five days a week, the cognitive stimulation group received stimulation in memory, problem solving skills, and fluency and communication skills. Each cognitive domain was targeted for an entire week, with memory being a focus for most weeks. The caregivers were assisted in how to improve interacting with the participants for one hour per week. The experimental group improved in immediate memory and verbal fluency post intervention, whereas the placebo group decline in functioning in these areas. The researchers also found a shortened intervention, an eight-week cognitive stimulation program, also found improvements in problem solving and verbal fluency for the

experimental group. This indicates that overall cognitive stimulation can improve some cognitive functioning among individuals diagnosed with dementia.

Cognitive stimulation has been found to be efficacious in improving cognition (Spector et al, 2003; Woods, 2002); however, more focused cognitive interventions may provide greater benefit for improving cognitive functioning in individuals experiencing progressive cognitive decline. Unlike cognitive stimulation or rehabilitation interventions, cognitive training involves more targeted intervention, aimed at impacting and stimulating the six primary cognitive domains that are impacted by dementia. These cognitive domains include attention, memory and learning, executive functioning, language, perceptual-motor skills, and social cognition.

Cognitive training interventions are standardized programs with a set of activities to target brain activation that gradually increases in difficulty as treatment progresses. Cognitive training can be implemented in a group or individual setting via computerized tasks or hands-on tasks. Research evaluating cognitive training interventions has focused on maintaining or even improving cognitive functioning. Currently, research investigating cognitive training has been focused on older healthy populations (Rebok et al., 2014); therefore, there is limited research on the efficacy of a cognitive training program for individuals who already have progressing cognitive decline.

Several studies have investigated cognitive training programs for individuals experiencing cognitive decline. For example, Moore, Sandman, McGrady, and Kesslak (2001), investigated a five-week memory-training program with 25 individuals with mild to moderate AD. The participant's caregivers served as age-matched controls, therefore,

the control participants performed higher on all outcome measures than the participants. There were slight improvements in performance on learning new information. Although limited, additional studies evaluating a cognitive training program on those with dementia have been conducted.

Loewenstein, Acevedo, Czaja and Duara (2004) evaluated a cognitive rehabilitation program with mildly impaired AD patients. Forty-four individuals were randomly assigned to receive cognitive rehabilitation or general cognitive stimulation. The experimental group received 24 individual training sessions that were computerized whereas the control group played general computerized memory games. The cognitive rehabilitation included tasks utilizing space retrieval, dual cognitive support, procedural memory activation, visuo-motor processing activation, and functional skills training. The results indicated that individuals who received the cognitive rehabilitation performed better at follow-up than compared to their pre-assessment scores. The neurocognitive battery assessed the six cognitive domains; the results indicate that the cognitive rehabilitation group performed better on the face-name association test, orientation, and making change for a purchase test.

Mate-Kole et al. (2007) assessed cognitive training and computer assisted programs among individuals diagnosed with a neurocognitive disorder. All six participants participated in a six-week intervention with three one-hour sessions a week. The programs focused on memory, attention, cognitive flexibility, manual dexterity, and problem solving skills. The participants did not show cognitive decline after the sessions, indicating a stabilization of cognitive functioning; furthermore, participants showed

improvements in overall cognitive functioning. This study contributes to the limited research, supporting the use of a cognitive training program for individuals already experiencing cognitive decline.

Further support for implementing a cognitive training program for individuals with dementia was illustrated with Kanaan et al. (2014). Kanaan and colleagues examined the efficacy of a cognitive training program focusing on attention and memory functioning in individuals with mild AD. The 21 participants took part in a cognitive training session everyday individually for 10 days. The training sessions lasts four to five hours every day, not including lunch and other short breaks. The training consisted of computer-based exercises targeting working memory, sustained attention, switching attention, and divided attention. Paper-and-pencil exercises were also included in the cognitive training session that worked memory, visual-spatial processing, sustained and selective attention, as well as practicing planning. The post-testing revealed higher scores on assessments than compared to the baseline assessments, for most but not all assessments. There was no difference in two assessments, assessing logical memory, sustained and switching attention as well as motor speed. The posttest measures were compared to a two and four month follow-up. The improvements found in visual scanning speed were maintained at both the two and four month follow-up. This suggests individuals with cognitive impairment, specifically in the early stages of dementia, can improve with cognitive training. Furthermore, these results provide some evidence of prolonged improvement, with individual's maintaining modest cognitive improvements

months after treatment. Therefore, there is some evidence that individuals with dementia can still improve with structured stimulation as found in cognitive training.

Purpose of the Study

The purpose of the current study is to evaluate the efficacy of a cognitive training program for individuals with moderate cognitive impairment. It is hypothesized that individuals in the cognitive training group will show stabilization or improvements in cognitive domains targeted by the cognitive training program at post-testing when compared to those assigned to the waitlist control group.

Method

Settings

Participant recruitment took place at four facilities in a small Midwestern city in the United States. Three of these facilities were assisted living and provided memory care services. One facility was a convent and provided assisted care for older nuns. The participants were assessed at the facilities in which they reside.

Participants

Participants were recruited by asking facility staff (i.e., activity directors) to identify residents who had a diagnosis of dementia or who displayed signs of cognitive impairment that affected their day-to-day (e.g., they needed assistance with personal cares). After obtaining consent from legal guardians, all potential participants completed an assent process and were administered the Modified Mini-Mental Status Examination (3MS; Tombaugh, et al., 1996). To be included in the study, participants needed to score between 77-48 on the 3MS, which indicates the presence of moderate cognitive

impairment. Exclusion criteria included a participant scoring lower or higher than the cutoff scores for the 3MS, significant disabilities that would impair participation in the cognitive training classes (i.e. blindness, deafness, significant language impairment), having a serious health problem, or medications that could interfere with cognitive functioning. Overall, ten individuals tested with the 3MS were not eligible for the study. Please refer to Appendix A for a list of the participants' notable diagnoses (i.e., diagnoses of dementia or mental health conditions) and medications being taken for memory loss, mental health conditions, or pain.

Twenty-four participants were eligible to participate in the study; however, two participants withdrew from the study. Therefore, the study included twenty-three participants with the average 3MS score of 66.23. There were 11 participants that were randomly assigned to the cognitive training classes and 12 participants assigned to the waitlist control condition. Follow-up data was not obtained from one control participant due to no longer living at the assisted living facility. A participant in the treatment group passed away, therefore, only partial follow-up data was obtained from this participant. Participant ranged in age from 64-97, and included one male and twenty-one females. All participants were white (n = 23). About an equal among of participants obtained a four-year degree or higher as the highest amount of education (n = 13), with the remaining participants obtaining a high school degree as the highest among of education (n = 10).

Materials

A battery of neuropsychological assessments were used to assess cognitive functioning prior to and following the cognitive training classes. The assessments used

were to evaluate the domains of cognitive functioning that were targeted by the cognitive training program: complex attention, language, executive functioning, perceptual-motor, social cognition, and learning and memory.

Modified Mini-Mental Status Exam (3MS). As mentioned previously, the 3MS was implemented prior to assessment to estimate the participant's current overall level cognitive functioning. The inclusion criteria for participants were to score within the range of moderate cognitive impairment (a cutoff score of 77-48). The 3MS is a standardized, commonly used assessment for this population and assesses for general cognitive impairment. This assessment was also re-administered after the intervention period. The 3MS has been found to be reliable with community dwelling and older adults with dementia ($d = .82$), furthermore the 3MS is sensitive in discriminating between those with and without a cognitive impairment (Tombaugh, et al., 1996).

Forward and Backward Digit Span. This test assesses attention by requiring participants to listen to a series of numbers orally presented and then repeat the numbers exactly as stated or backwards. The numbers were read to the participants by the researchers (Wechsler, 2008). The combined reliability coefficient is high, ranging from .93 to .95, for both the forward and backward digit span among those with dementia and dementia of the Alzheimer's type. The forward and backward digit span tests are also highly correlated with other measures of attention and with the WAIS-III digit span [$r = .72$] (Wechsler, 2008)].

Brief Test of Attention (BTA). The BTA measures attentional abilities requires participants to listen to a recorded voice reading a series of numbers and letters

(Schretlen, Bobholz, & Brandt, 1996). After each list presentation, participants reported how many numbers they heard in each list. Following this task, the participants were asked again to listen to the recording and only report how many letters was presented in each list. This test assesses attention abilities, has high reliability ranging from .82 to .91, no practice or performance affects, and strongly correlates with other tests for attention (Schretlen, et al., 1996).

Hopkins Verbal Learning Test (HVLT). The HVLT assesses a participant's verbal memory (Brandt & Benedict, 2001). In this test, the administrator reads aloud a list of words. Participants are asked to repeat as many of these words as they can remember. The list is than repeated two additional times to assess learning. A delayed recall tasks is then completed 20 minutes later, in which the participant is asked if they recall any of the words form the list. Finally, a recognition memory task is administered where the participant is read a series of words and asked if the word appeared on the original list. The HVLT is highly correlated with other tests of verbal learning and also accurately classifies 90.4% of individuals with and without AD (Shapiro, Benedict, Schretlen, & Brandt, 1999).

Brief Visuospatial Memory Test-Revised (BVMT-R). The BVMT-R assesses a participant's visual memory (Benedict, 1997). For this test, the participant is asked to study a display of six figures for 10 seconds. Then the display is removed and the participant is asked to try and draw these figures as best as they can in the correct location on the provided paper from memory. This is completed three times. A delayed recall task is completed 20-25 minutes later; the participant is given various figures, some

of which were on the original display and others were not, and the participant is asked to indicate if a figure was or was not on the original display. The BVMT-R has good test re-test reliability and is highly correlated with other assessments used for measures on learning and memory (Benedict, Schretlen, Groninger, Dobraski, & Shpritz, 1996).

Controlled Oral Word Association Test (COWAT). The COWAT is a measure of language abilities that requires participants to name all words, excluding proper names or similar words with a different ending, that begin with a specific letter in one minutes; the participant then repeats this with a different letter. The COWAT has high reliability and is highly correlated with other neuropsychological tests (Benton & Hamsher, 1989).

Clock Drawing Test. To assess visual spatial skills, the Clock Drawing Test was administered (Tuokko, H., Hadjistavropoulos, Y., Miller, J. A., & Beattie B. L., 1992). For this test, participants are asked to draw the face of a clock inside of a circle on a standard sheet of paper. Then they are instructed to draw the hands of the clock to read ten minutes after eleven o'clock. The clock drawing test is a sensitive assessment tool for differentiating healthy older adults from those with dementia, with a kappa coefficient of .81 (Tuokko, Hadjistavropoulos, Rae, & O'Rourke, 2000). This assessment also has high inter-rater reliability ranging from 97-99% (Tuokko et al., 2000).

Trail Making Test Part A and B. The Trail Making Test is a commonly used measure of executive functioning and perceptual speed (Reitan & Davison, 1974). The test has two parts. Part A requires the participants to draw a line, connecting circles with numbers 1 through 25, in consecutive order. They are asked to connect these circles as

quickly as they can with the circles spread randomly throughout the sheet of paper. Part B of this test is similar, however, the participant is asked to connect circles as quickly as possible with letters and numbers in consecutive order switching from a number to a letter. This assessment is sensitive in detecting brain damage and cognitive impairments from matched controls, and is correlated to general intelligence (Reitan & Davison, 1974; Reitan, 1958; Reitan, 1959)

Cognitive training program. The cognitive training program used in this study was called Active Mind and was developed by a non-profit organization, the New England Cognitive Center (NECC). This cognitive training course is a twelve-week intervention and the complexity of the classes' progresses and becomes more difficult. A total of 24 classes are completed, with two classes being completed each week. This specific program is designed for individuals with moderate cognitive impairment. The classes include six different activities that focus on the six primary cognitive domains discussed earlier (i.e., reaction time, attention, memory, language, visual-spatial skills, and executive functioning). The activities are designed to be appropriate for adults with little instruction time and minimal in-class guidance needed. The program has been developed over the past several years with extensive field-testing, but limited empirical testing.

Procedure and Research Design

A randomized control trial was used to evaluate the efficacy of the Active Mind cognitive training course. Participants were either randomly assigned to a waitlist control group, or to participate in the cognitive training classes. As mentioned, the participants were assessed prior to and after the cognitive training classes. To reduce cognitive fatigue as well as to separate similar assessment tasks, assessments were broken into two sessions. Each participant was involved in two assessment sessions prior to and after the cognitive training course. These assessment sessions lasted for approximately 20-30 minutes. The researchers were responsible in administering all assessments to the participants. Assessments were either completed in the participant's apartment or in common area in the facility, the location was based on the participant's preference. The cognitive training classes were also held at the assisted living facilities in rooms that held normally held activities for residents.

The facilities activities directors led the cognitive training courses. The activities directors were trained in how to lead this program by the director of the New England Cognitive Center (NECC), in which created the cognitive training program, as well as the training materials provided by the NECC. Participant attendance to the cognitive training classes was tracked and recorded. Participants completed 75% or more of the classes throughout the duration of the intervention.

Results

Cohen's *d* effect sizes were used to evaluate changes in cognitive functioning. Effect sizes were used to determine the impact of the intervention due to the small sample

size, which limited the statistical power available to conduct inferential statistics such as repeated measures ANOVAs. To interpret effect size statistics, Cohen's (1988) recommended cutoff scores were used. Small effect sizes range from 0.2 to 0.49, medium effect size ranged from 0.5 to .79, and large effect sizes ranged from 0.8 and above. For within subject comparisons, in order to account for the dependence between the means, the correlations between the means was taken into account and Equation 8 was applied (Morris & DeShon, 2002; Morris, 2008).

Three sets of analyses were completed. First, to assess differences in cognitive functioning between the treatment and control conditions, effect sizes were analyzed between groups using post-treatment scores. Second, to assess changes in cognitive functioning among those who were in the treatment condition, effect sizes were completed to compare pre- and post-treatment scores. Third, to assess changes in cognitive functioning among those who were in the control condition, effect sizes were completed to compare pre- and post-treatment scores. The means, standard deviations, and effect sizes for comparing the treatment and control group's post-treatment scores can be found in Table 1. The means, standard deviations, and effect sizes comparing pre- and post-treatment scores for the treatment and control group are shown in Tables 2 and 3 respectively.

Modified Mini Mental Status Examination

To evaluate the randomization of participants in the treatment and control groups, an independent samples t-test was completed on pre 3MS scores. The Leven's test for equal variances was violated, therefore, equal variance is not assumed. There is a

significant difference between treatment and control groups pre 3MS scores ($t(14.42) = -2.93, p = 0.01$), in which the treatment group on average scored higher ($M = 71.55, SD = 3.88$) than the control group ($M = 62.33, SD = 10.09$). Because of this pre-treatment difference, the between group comparisons should be interpreted with caution.

Treatment and control participant's mean 3MS post-treatment scores were compared. There was a positive large effect ($d = 1.10$), in which those in the treatment condition had post 3MS scores that, on average, were higher than those in the control group. Participant's pre and post-treatment 3MS scores among those in the treatment group revealed a negligible effect size ($d = 0.03$). The control 3MS scores declined over time, with a medium effect size being found ($d = 0.43$).

These results indicate that the post 3MS scores between the groups were different enough to produce a large effect size. Furthermore, the control group's overall cognitive functioning, as measured using the 3MS, declined from pre- to post-treatment. Those in the treatment group, however, did not show decline (nor improvement) on this measure of overall cognitive functioning.

Attention

Forward and Backward Digit Span. The forward digit span assessed the participant's ability to recall a list of numbers presented orally and is a commonly-used test of simple attention. There was a large effect ($d = 0.94$) in the ability to recall numbers between the treatment and control groups' post-treatment scores. Specifically, those in the treatment group, on average, performed better than those in the control group. There was a small positive effect size ($d = 0.18$) between the pre and post forward

digit span scores among those in the treatment group. There was also a small positive effect size ($d = 0.18$) for forward digit span between pre- and post-treatment score among those in the control group. Therefore, there were small improvements over time in both the treatment and control groups; however, at post-treatment, there were large differences between groups.

The backward digit span test, which requires the ability to recall and reverse numbers presented orally, is a commonly-used measure of complex attention. At post-treatment there was a large between-group effect size ($d = 1.18$), in that those in the treatment condition had higher mean scores than those in the control conditions. The treatment group's pre and post backward digit span has a large effect size ($d = 1.02$), where the post-treatment mean scores are higher than the pre-treatment scores. A small effect size ($d = 0.39$) was found when examining differences between pre- and post-treatment scores in the control group. However, the control group's pre-treatment scores were on average higher than the post treatment scores, indicating decline on this measure over time. The treatment group's backward digit span post-treatment scores were higher than the control groups; furthermore, the treatment group performance improved at post assessment, whereas the control group's performance declined over time.

Brief Test of Attention. The BTA is a measure of simple attention. The BTA total score is the combined performance of trial one, which asked participants to keep track of only how many numbers are presented orally on a list of numbers and letters, and trial two, which asked participants to keep track of only how many letters were presented. There was a small positive effect ($d = 0.40$) between the treatment and control group's

post-treatment scores. Specifically, the treatment group had higher scores on the BTA than the control group. When comparing the treatment group's pre and post BTA total scores, the performance at post-treatment was higher with a small positive effect size ($d = 0.25$). The control group's performance on the pre and post BTA also improved at post-treatment with a small positive effect size ($d = 0.41$). The treatment group had higher BTA total scores than the control condition; however, both treatment and control groups BTA total scores increased over time.

Memory Functioning

Hamilton Verbal Learning Test-Revised. The HVLT-R is a commonly-used measure of memory and learning. The HVLT-R total recall score, which includes the total number of words recalled after three repetitions, represents a measure of immediate recall and learning. This measure showed a large effect size when comparing the average scores of the treatment and control conditions ($d = 1.43$). The treatment condition's pre and post-treatment HVLT-R total recall scores revealed a negligible effect ($d = 0.07$), indicating little change on this measure over time. The control group's pre and post HVLT total recall assessment scores produced a small negative effect size ($d = 0.38$); specifically, the post mean scores were smaller than the pre mean score. Therefore, those in the control condition declined in their ability to recall words, whereas those in the treatment condition did not decline in the ability to recall words post-treatment. Furthermore, the post-treatment HVLT-R total recall differed between the control and treatment conditions, in that those in the control condition performed on average lower than the treatment condition.

The HVLT-R delayed recall index, which assessed the participant's ability to remember words from the previously presented list after 20-25 minutes, produced a medium effect ($d = 0.79$) when examining between-group differences. More specifically, the treatment group had higher mean scores than the control group at post-treatment. The treatment group's mean HVLT-R delayed recall scores were negligible between pre and post-treatment ($d = 0.05$). The control groups pre and post HVLT-R delayed recall also had a negligible effect between pre and post-treatment ($d = 0.00$). The treatment and control group post-treatment HVLT-R delayed recall differed, in that the treatment group had on average higher mean post-treatment scores. However, there were no changes in delayed recall over time in either group.

The HVLT-R recognition memory test assesses the participant's ability to recognize words from a previously presented list of words. The post-treatment between-group effect size was medium ($d = 0.76$) suggesting that those in the treatment group had a higher mean HVLT-R recognition score than the control group. There was a small effect in the pre and post-treatment recognition memory scores for those in the treatment group ($d = 0.20$), in which the post recognition score is higher than the pre assessment score. A negligible effect was found between the pre and post HVLT-R recognition scores among the control group ($d = 0.01$). Therefore, the participant's ability to accurately recognize words that were presented earlier differed between the treatment and control groups, in that the treatment group performed better than the control group at the post-treatment time period. There was also a small positive effect on this measure of

recognition memory over time in the treatment group whereas no change was observed over time in the control group.

Brief Visuospatial Memory Test-Revised. The BVMT total recall score represents a participant's ability to recall various figures and draw such figures from memory on three consecutive trials. The treatment group's performance on the post BVMT total recall was higher than in the control group, with a small positive effect ($d = 0.46$). The treatment group's pre and post BVMT total recall improved from pre to post with a medium positive effect size ($d = 0.60$). The control group's BMVT total recall scores also improved from pre to post treatment with a small positive effect ($d = 0.31$). Overall, both treatment and controls performance on the BVMT total recall was higher at post assessment; however, the treatment group's post assessment scores were higher than the control group.

The BVMT delayed memory test assessed the participant's ability to recall various figures displayed 20-25 minutes earlier and draw those figures from memory. The treatment group's BVMT delayed score was higher than the control group with a medium positive effect size ($d = 0.71$). The treatment group's pre and post BMVT delayed scores produced a small negative effect ($d = 0.30$), in which performance at pre-treatment was better than at the post-treatment time period. A small negative effect size ($d = 0.31$) was also found in the control group from pre- to post-treatment, indicating that delayed visual memory performance declined over time. The treatment group's post BMVT delayed assessment score was higher than the control groups; however, both

treatment and control groups BMVT delayed memory score declined from pre- to post-treatment.

The BVMT discrimination index assesses visual recognition memory by asking participants to determine whether a series of pictures were on the original display or not. The treatment group's post BVMT discrimination score was higher than the control group with a positive medium effect size ($d = 0.62$). The treatment group's performance on the BVMT discrimination improved from pre- to post-treatment with a small positive effect size ($d = 0.27$). There was no effect between the pre and post BMVT discrimination scores among the control group ($d = 0.10$). Visual recognition memory scores were higher in the treatment group compared to the control group at post-treatment. Over time, visual recognition memory improved slightly in the treatment group, but generally remained unchanged in the control group.

Language

The COWAT letter fluency total score is calculated by counting the number of words a participant can name that begin with a certain letter within a minute (excluding all repeated words, proper nouns, and words that began with a different letter). There was a negligible between-group effect size at post-treatment ($d = 0.05$). The treatment group's performance on the COWAT was higher at pre-treatment compared to post-treatment, with a negative medium effect size ($d = 0.76$) being found. The control group's performance on the COWAT pre and post assessment also declined with a small negative effect size ($d = 0.31$). Overall, the performance on the COWAT declined for

both the treatment and control groups with the control group performing better than the treatment group post treatment.

Visuospatial Skills

The Clock Drawing Test is a commonly-used measure of visuospatial skills and requires the participant to draw the face of a clock with the hands reading 10 after 11. Scores can range from one to six, with one being the highest score and six being the lowest score. Post-treatment scores differed between the control and treatment groups, in which the treatment group on average performed lower than the control group with a small negative effect size ($d = 0.21$). The treatment group's pre and post treatment scores had a negligible effect size ($d = 0.03$). The control group's pre and post treatment scores produced a small positive effect in which the performance on the clock drawing test improved at post-treatment ($d = 0.30$). Therefore, the participant's in the treatment group performed lower than the participants in the control group at post treatment, and the control group's performance improved post treatment.

Executive Functioning

The Trail Making Test Part A is a commonly-used measure of executive functioning and is scored according to how long it takes participants to complete the task. There was a positive large effect ($d = 0.81$) between the treatment and control group post-treatment scores, in which the control group on average took longer to complete the task than those in the treatment group. There was a small positive within-group effect size ($d = 0.26$) in the treatment group, suggesting that participants were able to complete the task faster at post-treatment. There was a small negative effect ($d = 0.26$) between pre and

post-treatment scores in the control group such that participants took longer to complete Trails A at post-treatment. Overall, the treatment group performed faster on Trails A than the control group. Also, the treatment group improved over time while the control group's performance declined over time.

Trail Making Test Part B, is a more complex task in that it requires participants to switch attention between numbers and letters (e.g., connecting 1 to A, A to 2, and 2 to B). There was a large negative effect ($d = 0.77$) in performance between treatment and control groups at post-treatment indicating that the control group completed Trails B faster than the treatment group. The treatment group's performance on Trails B improved from pre- to post-treatment ($d = 0.39$), while the performance of the control group declined over time ($d = 2.02$). Overall, the control group completed Trails B at post assessment faster than the treatment group; however, the treatment group's performance on Trails B improved from pre- to post-treatment, whereas the performance of the control group declined over time.

Discussion

Because a variety of measures were used that assessed a number of different cognitive domains, general statements about the efficacy of the cognitive training program used in this study cannot be made. Results of this study, however, indicate a number of promising benefits in terms of cognitive functioning associated with the Active Mind cognitive training program. The following paragraphs will provide an overview of the finding for each cognitive domain.

Cognitive domains where positive treatment effects were found between pre- and post treatment among those in the treatment condition included verbal memory recognition, recognition memory, learning, simple attention, complex attention, executive functioning, and visual memory. The treatment group maintained, or had stable scores between pre-and post-treatment in verbal memory recall, general cognitive functioning, and visuospatial.

The treatment group also declined in a few areas. Specifically, the areas in which the treatment group declined included visual memory and language. The control group also declined in these areas; however, the control group declined in more cognitive domains than the treatment group. The control group declined in the additional following areas, overall cognitive functioning, verbal memory, complex attention, executive functioning, and attention.

Any improvement is quite promising given the progressive nature of dementia and cognitive decline. In contrast the control group declined in more cognitive domains than the treatment group.

The findings of the current study support the limited research evaluating the impact of cognitive training among individuals with cognitive decline. Individuals who already present with cognitive decline may improve with structured stimulation with a cognitive training program. As found in previous studies, individuals with cognitive impairment can improve in learning (Moore et al, 2001), overall cognitive functioning (Mate-Kole et al., 2007), working memory, and attention (Kanaan et al., 2014).

Limitations and Future Directions

While the findings of the current study appear promising, there are a few limitations that should be noted when interpreting the findings. The sample was randomly assigned to treatment or control conditions; however, this assignment did lead to a significant difference in 3MS scores between the groups prior to treatment. The control condition had significantly lower 3MS scores, meaning that those in the control condition on average had lower overall cognitive functioning than those in the treatment group. This difference impacts the ability to interpret the between group effect sizes, and should be taken into account when reviewing the results. Inferential statistics that allow the researcher to statistically equate groups on important pre-treatment measures (such as the 3MS) would have been preferable had the sample sizes in each group been larger. The 3MS scores did differ between treatment and control groups; however, the 3MS scores were not statistically significantly different between facilities ($F(3, 23) = .67, p = .580$). Therefore, the randomly assigned participants within the facilities were not significantly different.

Because this was a field study conducted in four different facilities, there was a lack of control over certain elements of the study. For example, even with the class administrators being trained all together by the director of NECC, the administration of classes might have differed slightly across sites. Specifically, the amount of direct assistance may have fluctuated across activity directors. The directors could have developed idiosyncrasies in the administration of the structured classes. Furthermore, due to different conflicting schedules, there were weeks in which the classes were offered two versus three times a week. This schedule may have varied across facilities. Future

research should focus on developing measures of treatment adherence and competence to help ensure consistent administration of cognitive training classes over time and across sites.

Another limitation is the ability to assess all participants at the same time, due to availability of the participants and the time it takes to complete assessments, all participants could not be assessed during the same week or time of day for pre and post assessments. Usually, the assessments were completed within two weeks for both pre and post assessments; however, the time difference especially in the post assessments could have led to slight differences in scores.

Due to the small sample size, inferential statistics were not conducted. Future research should include larger samples that will allow between group comparisons using inferential statistics, such as ANOVA, to evaluate the impact of cognitive training between the treatment and control groups as well as the impact of the intervention over time. Also due to time restraints, follow-up assessments were limited. Future research should include a follow-up assessment to evaluate the long-term impact of a cognitive training intervention. Future research should also control for or use matched controls for cognitive functioning to better assess differences in cognitive functioning pre and post treatment. Matching participants in terms of 3MS scores or another cognitive functioning measure would allow for more confident interpretations of the findings.

Implications and Conclusions

The findings of this study tentatively support the use of a structured cognitive training program for individuals with moderate stage dementia. Given that some

cognitive abilities improved and others stabilized in the intervention group is quite promising given the progressive nature of dementia and cognitive decline. Also, there are relatively few cognitive training programs specially designed for this population.

The implications of this study suggest that the implementation of a cognitive training course may improve certain aspects of cognitive functioning. This finding is important as the aging population is increasing. In fact, it is estimated that by 2030, there will be about 72.1 million people 60 years and older (U.S Department of Health and Human Services, 2015). Furthermore, the prevalence of cognitive decline and dementia is around 5.4 million older adults in the United States (Alzheimer's Association, 2015). Utilizing a cognitive training course to help stabilize cognitive abilities may prolong the ability for older adults with dementia to live with family members instead of the necessity of living in an assisted living facility. Interventions may improve individuals functioning, quality of life, and their caregiver's quality of life. The utilization of a cognitive training course in assisted living facilities could also have an impact in improving quality of life and work burden on staff members.

The cognitive training classes had good social validity. The cognitive training courses were well received among the facilities involved in the current study. Training activities directors in implementing the classes was successful and classes can be disseminated easily. Overall, the activity directors reported enjoying implementing the classes and reported most of the residents had a good experience. Therefore, the classes were not only found to be effective in improving certain aspects of cognitive functioning, but the program is likely to actually be used among facilities.

Table 1.

Treatment and control post assessment means and standard deviations

Assessment	Treatment Mean (SD)	Control Mean (SD)	Cohen's <i>d</i>	Effect size And direction
3MS	71.36 (8.13)	60.18 (12.11)	1.10	Large +
HVLT-R total recall	14.00 (5.39)	7.18 (4.14)	1.43	Large +
HVLT-R delayed recall	1.73 (2.24)	.36 (1.21)	0.79	Medium +
HVLT-R recognition	4.73 (2.53)	2.45 (3.45)	0.76	Medium +
Forward digit span correct	9.82 (2.60)	7.55 (2.25)	0.94	Large +
Backward digit span correct	7.27 (1.49)	5.09 (2.21)	1.18	Large +
Trail making test A	82.18 (28.86)	139.09 (111.87)	0.81	Large +
Trail making test B	222.86 (71.38)	166.00 (76.99)	0.77	Large -
BMVT Total Recall	4.50 (4.28)	3.00 (2.32)	0.46	Medium +
BMVT Delayed	.50 (.85)	.09 (.30)	0.71	Large +
BMVT Discrimination Index	2.70 (1.25)	1.73 (1.90)	0.62	Medium +
Letter Fluency Total	14.78 (4.44)	15.18 (10.74)	0.05	NS size
Clock test	3.40 (1.35)	3.71 (1.62)	0.21	Small -
BTA total	6.50 (4.72)	4.72 (4.24)	0.40	Small +

Note: NS refers to not a significantly large effect size

Table 2.

Treatment condition pre and post assessment means and standard deviations

Assessment	Pre Mean (SD)	Post Mean (SD)	Cohen's <i>d</i>	Effect size and direction
3MS	71.55 (3.88)	71.36 (8.13)	0.03	NS size
HVLT-R total recall	13.72 (4.34)	14.00 (5.39)	-0.07	NS size
HVLT-R delayed recall	1.82 (2.40)	1.73 (2.24)	0.05	NS size
HVLT-R recognition	4.09 (4.93)	4.73 (2.53)	0.20	Small +
Forward digit span correct	9.45 (2.42)	9.82 (2.60)	0.18	Small +
Backward digit span correct	5.91 (1.14)	7.27 (1.49)	1.02	Large +
Trail making test A	94.08 (39.97)	82.18 (28.86)	0.26	Small +
Trail making test B	251.50 (84.75)	222.86 (71.38)	0.39	Small +
BMVT Total Recall	2.09 (2.98)	4.50 (4.28)	0.60	Medium +
BMVT Delayed	.90 (1.81)	.50 (.85)	0.30	Small -
BMVT Discrimination Index	2.27 (2.00)	2.70 (1.25)	0.27	Small +
Letter Fluency Total	19.55 (7.90)	14.78 (4.44)	0.76	Medium -
Clock test	3.45 (1.57)	3.40 (1.35)	0.03	NS size
BTA total	5.55 (4.20)	6.50 (4.72)	0.25	Small +

Note: NS refers to not a significantly large effect size

Table 3.

Control condition pre and post assessment means and standard deviations

Assessment	Pre Mean (SD)	Post Mean (SD)	Cohen's <i>d</i>	Effect size and direction
3MS	62.33 (10.09)	60.18 (12.11)	0.43	Medium -
HVLT-R total recall	8.33 (3.17)	7.18 (4.14)	0.38	Small -
HVLT-R delayed recall	.17 (.58)	.36 (1.21)	0.00	NS size
HVLT-R recognition	2.42 (3.18)	2.45 (3.45)	0.01	NS size
Forward digit span correct	7.25 (2.53)	7.55 (2.25)	0.18	Small +
Backward digit span correct	5.67 (1.78)	5.09 (2.21)	0.39	Small -
Trail making test A	94.03 (60.21)	139.09 (111.87)	0.26	Small -
Trail making test B	123.00 (46.03)	166.00 (76.99)	2.02	Small -
BMVT Total Recall	1.83 (2.44)	3.00 (2.32)	0.31	Small +
BMVT Delayed	.33 (.65)	.09 (.30)	0.31	Small -
BMVT Discrimination Index	2.00 (1.65)	1.73 (1.90)	0.10	NS size
Letter Fluency Total	18.25 (7.71)	15.18 (10.74)	0.31	Small -
Clock test	4.08 (1.51)	3.71 (1.62)	0.30	Small +
BTA total	3.50 (3.83)	4.72 (4.24)	0.41	Small +

Note: NS refers to not a significantly large effect size

Appendix A*Diagnoses and Medications*

Participant	Diagnoses	Medications
HVXMM5	Diabetes	Vitamin E
FGXMM4	Dementia Depression Chronic Pain Anxiety Insomnia	Aricept Namenda Citalopram Gabapentin
MEXMM2	Dementia Hypertension Osteoarthritis High Cholesterol	Citalopram Exelon Namenda
RJXMM1	Depressive Disorder Hypertension High Cholesterol	Mirtazapine Namenda
KWXMM3	Dementia	No medications specific for dementia or psychiatric conditions
JRXOT2	Diabetes Hypertension	No medications specific for dementia or psychiatric conditions
TMXOT3	Alzheimer's Disease	Aricept Sertraline
SRXOT5	Vascular Dementia Uncomplicated Depression Anxiety unspecified	Aricept Olanzapine
CFXOT8	Congestive heart failure High blood pressure	Namenda
HMXOT09	Memory loss	Namenda Seroquel Aricept
PPXEPL1	Dementia Hyperlipidemia	Aricept
VVXEPL2	High blood pressure	No medications specific for dementia or psychiatric conditions
GMVEPL4	High blood pressure Vascular dementia	Lexapro
ARMSCG3	Atherosclerotic coronary Arteriovascular disease High Cholesterol Hypertension	

KISGC7	Dementia due to Alzheimer's disease Arthritis Type II diabetes Mild cognitive disorder	Aricept Lexapro Ativan
UESGC8	Arthritis Dementia due to Alzheimer's disease Hyperlipidemia Hypertension	Aricept Namenda Tofranil
SVSGC10	Dementia Alzheimer's type Arthritis Chronic back pain Depression	Nerontin Zoloft Ativan
BCMSGC12	High cholesterol Hypertension Dementia	Neurontin Razadyne (galantamine)
BMSGC13	Dementia Depression Osteoarthritis Hypertension	Aricept Celexa
MCSGC14	Dementia Congestive heart failure Coronary artery disease High cholesterol	Razadyne (galantamine)

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