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The Effects of Cognitive Training Program for Cognitively Impaired Older Adults: A Pilot Randomized Control Trial

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ABSTRACT

Objective: This pilot investigation evaluated the effectiveness of a cognitive training program for older adults with cognitive impairment.

Methods: A sample of 23 individuals were randomly assigned to either a 24-session cognitive training program or a wait-list control group. Cognitive training sessions required participants to complete activities that targeted the following cognitive domains: attention, visual and verbal memory, visual spatial skills, processing speed, executive functioning, and language. A battery of cognitive tests were administered prior to and immediately after completion of the program. Depression, quality of life, agitated behavior, and daily functioning were also assessed.

Results: Small to large effect sizes on half of the cognitive outcome measures were observed following participation in the program. No positive effects were found with regard to non-cognitive outcomes.

Discussion: These results warrant further investigation into the benefits of this cognitive training program in larger randomized control trials.

Clinical Implications: The cognitive training program may provide activity staff in assisted living or memory care settings a highly structured, manualized, and user-friendly intervention for older adults experiencing cognitive decline.

Keywords: aging, cognitive training, cognitive impairment

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Declines in certain cognitive abilities such as processing speed and some forms of memory are relatively normal in older adulthood, although these declines typically do not negatively affect daily functioning.[1] For some older adults, however, declines in cognitive functioning progress to the point where completing day-to-day activities independently becomes difficult or dangerous. In fact, over 46 million individuals worldwide live with dementia and estimates are these numbers could rise to over 131 million by 2050.[2]

Although medications are available that can slow the progression of cognitive decline, the effects are generally temporary and may not be clinically meaningful.[3] Consequently, professionals have investigated the possible benefits of non-pharmacological approaches for slowing cognitive decline and enhancing quality of life. One such approach is *cognitive training*, which uses guided practice on a set of standardized tasks to target and improve specific cognitive functions such as memory or language. [4]

Most cognitive training programs are designed to prevent cognitive decline in older adults not yet experiencing significant cognitive impairment. However, a small body of literature has examined the possible benefits of cognitive training for persons already experiencing cognitive decline. This literature has produced highly variable results. For example, some studies have found positive effects on various cognitive abilities.[5-7] In addition, a review of 19 studies found large effects on measures of verbal memory .[8]

Conversely, a review of 11 randomized control trials found that cognitive training was not associated with positive or negative effects on any outcome measures.[4] Another meta-analysis of 19 studies concluded effect sizes were negligible to low on cognitive and functional outcome measures and the majority of studies were of low to moderate scientific quality.[9] In addition, even when benefits occurred, there was no evidence that benefits transferred to untrained tasks or everyday situations.

The purpose of the current pilot study was to explore the efficacy and feasibility of a cognitive training program for individuals with cognitive impairment of moderate severity. The study was intended to add to the small number of randomized control studies in this area. Because findings in the existing literature have varied widely across studies, no specific hypotheses were asserted regarding the benefits of the training program and all analyses were exploratory in nature.

Method

Settings and Participants

Participants were recruited from four facilities in a small metropolitan area in the Midwestern United States. Three were assisted living facilities with memory care units, while the fourth was a health care facility that provided assisted care for older nuns.

Recruitment involved asking facility staff to identify residents diagnosed with a neurocognitive disorder or who otherwise displayed signs of cognitive impairment. After consent forms approved by the Institutional Review Board were signed by legal guardians, individuals were administered the Modified Mini-Mental Status Examination (3MS).[10] Participants who scored in the “moderate impairment” range (between 77-48) were included in the study, as this is the population for which the cognitive training program was designed. The mean 3MS score was 66.7 (*SD* = 8.94).

Exclusion criteria included a 3MS score outside the 77-48 range or the presence of significant visual, hearing, or motor impairments that could prevent successful participation in the program. The presence of a neurocognitive disorder was not required for inclusion, nor was the absence of a neurocognitive disorder an exclusion criterion. This was the case because staff observed that many individuals were experiencing genuine cognitive decline, but

never received formal diagnosis of neurocognitive disorder. Therefore, diagnostic status appeared to be an imperfect indicator of the severity of cognitive impairment and appropriateness for the program.

Twenty-three individuals participated in the study. All participants were Caucasian, and included twenty-two females and one male ranging in age from 64 to 97 (*M* = 86.3; *SD* = 7.22). Thirteen participants obtained a four-year degree or higher while the remaining ten participants obtained a high school diploma. Fourteen individuals had a neurocognitive disorder (*n* = 7 in both the treatment and control groups) and thirteen of them took medications for their condition. The dosages of all medications remained unchanged throughout the study. All participants completed at least 75% of the classes (range = 75-100%, *M* = 92.1%).

Materials

The cognitive training program used in this study was designed to be appropriate for adults with moderate cognitive impairment. A master trainer from the organization that developed the program trained activity staff to deliver the program and provided them with a detailed treatment manual. The program included 24, one-hour classes delivered 2-3 times a week over an 8-12 week period. Classes comprised of 3-5 individuals and included a sequence of activities related to six cognitive domains: reaction time, attention, visuospatial skills, short-term verbal memory, language, and problem solving. Activities took approximately 5-12 minutes and gradually increased in difficulty as the program progressed.

Table 1 Outcome Measures

Cognitive Domain	Instrument
Global Cognitive Ability	Modified Mini-Mental State Examination (3MS)[10]
Attention	Forward & Backward Digit Span[14] Brief Test of Attention[15]
Visual Memory: Immediate recall, delayed recall, and recognition memory	Brief Visuospatial Memory Test – Revised[16]
Verbal Memory: Immediate recall, delayed recall, and recognition memory	Hopkins Verbal Learning Test[17]
Visual Spatial Skills	Clock Drawing Test[18]
Processing Speed	Trail Making Test Part A[19]
Executive Functioning	Trail Making Test Part B[19]
Language	Controlled Oral Word Association Test[20]
Depression	Patient Health Questionnaire-9 Observer Version[21]
Quality of Life	QUALIDEM[22]
Agitated Behavior	Cohen-Mansfield Agitation Inventory[23]
Daily Functioning	Functional Status measure from Minimum Data Set 3.0[24]

Research Design and Procedure

Participants were randomly assigned to either the cognitive training program (n = 11) or a waitlist control group (n = 12). Within one week prior to starting the program, the researchers administered a battery of neuropsychological tests assessing the six cognitive domains targeted by the program. In addition, nursing staff who knew participants for at least three months completed measures of emotional, behavioral, social and daily functioning. All outcome measures were repeated within one week upon completion of the program (see Table 1).

Results

Due to the small sample size, a single Cohen's *d* effect size (ES) was calculated for all outcome measures to determine the clinical magnitude of the intervention. ES was calculated in the following way: the numerator of the formula was calculated by subtracting the difference between pre-treatment and post-treatment means for the control group from the pre-treatment to post-treatment difference for the experimental group. The denominator of the formula was the average of the standard deviations for the control group and experimental group at pre-treatment.[11] According to Cohen,[12] an ES of .2 is small, .5 is medium, and .8 is large.

Table 2 Effect Size for All Outcome Measures

Domain	Cohen's d
General Cognitive Functioning (3MS)	0.28*
Simple Attention (Digits forward)	0.03
Divided Attention/Working Memory (Digits backward)	1.33***
Divided Attention (BTA)	-0.07
Immediate Verbal Recall (HVLT)	0.38*
Delayed Verbal Recall (HVLT)	-0.19
Verbal Recognition (HVLT)	0.15
Immediate Visual Recall (BVMT-R)	0.48**
Delayed Visual Recall (BVMT-R)	-0.13
Visual Recognition (BVMT-R)	0.38*
Language/Executive Functioning (COWAT)	-0.22
Visual-Spatial (Clock Drawing)	-0.21
Perceptual Speed (TMT-A)	1.14***
Executive Functioning (TMT-B)	1.10***
Depression	0.07
Quality of Life	-0.23
Daily Functioning	0.21
Agitated Behavior	-0.29

*Small treatment effect **Medium treatment effect ***Large treatment effect

As can be seen in Table 2, the intervention group showed superior functioning at post-treatment on measures of seven cognitive domains: general cognitive functioning (small ES), divided attention/working memory (large ES), immediate recall for verbal material (small ES), immediate memory of visual material (medium ES), recognition of visual material (small ES), perceptual speed (large ES), and cognitive flexibility/executive functioning (large ES).

There were no group differences on measures of five cognitive domains (i.e., simple attention, divided attention, recognition of verbal material, and delayed recall of verbal and visual material). Small effect sizes favoring the control group were found on measures of language and visuospatial skills. On measures of agitated behavior, quality of life or daily functioning, the treatment group actually showed small declines (i.e., inferior performance) compared to the control group, while there were no group differences with regard to depressive symptoms.

Discussion

Although the study produced mixed findings, the results showed some benefits associated with a comprehensive cognitive training program for individuals with moderate cognitive impairment. Seven of fourteen cognitive domains showed some improvement when comparing treatment and control groups. These differences include small effects in general cognitive functioning, immediate verbal recall, and visual recognition; a medium effect on immediate visual recall; and large effects on complex attention, processing speed, and executive functioning. These findings are consistent with previous studies showing individuals with cognitive impairment can improve in processing speed,[6] verbal learning,[8] overall cognitive functioning ,[7] and working memory.[5]

Other results were consistent with findings from meta-analyses that suggest cognitive training does not benefit persons with cognitive impairment.[4,9] For example, negligible effect sizes were found on measures of five cognitive domains and the measures of language and visual-spatial skills showed declines. Finally, measures of depressive symptoms, frequency of behavioral problems, daily functioning, and quality of life showed no improvements. These results are consistent with previous research suggesting that even when cognitive functioning improves, benefits do not necessarily generalize to everyday functioning.[9]

Follow-up interviews revealed that the program was well received among staff. Staff reportedly found the classes easy to administer and incorporate into their normal activity schedule, and classes required minimal (<10 min) preparation and clean up time. Staff also reported that most residents enjoyed the classes and no adverse events occurred.

Limitations and Future Directions

Although the study produced some encouraging results, there were several important limitations. First, the sample was small and homogenous with regard to gender and ethnicity. Conversely, the sample was heterogeneous with regard to the presence of preexisting medical and psychiatric conditions. Although individuals diagnosed with neurocognitive disorders were equally distributed between groups, these individuals would be expected to show a different rate of cognitive decline over time compared to individuals with no diagnosis, thus making it more difficult to establish the effects of the cognitive training program beyond natural rates of cognitive decline. Moreover, those with no diagnosis of neurocognitive disorder showed moderate cognitive impairment on the 3MS, raising the possibly that they actually had some form of neurocognitive disorder, but had not been formally diagnosed. Future studies would benefit from larger and more demographically diverse samples, more homogenous samples in terms of preexisting diagnoses of neurocognitive disorder, and matching participants in experimental conditions with regard to the severity of pre-treatment cognitive functioning.

Because this was a field study, there was a lack of control over certain elements of the study. For example, due to scheduling conflicts, the

number of classes offered each week varied both within and across facilities. In addition, although detailed treatment manuals were provided to class facilitators, it is unclear how reliably the classes were implemented. Therefore, it will be important to measure treatment adherence in order to ensure consistent administration of the program over time and across sites.

Future research should adhere to more consistent testing schedules than were implemented in this study. For example, testing was conducted on two different days to prevent fatigue, and although testing sessions typically occurred on consecutive days, this was not always possible. In addition, testing did not always occur at the same time of day due to unpredictable schedules of participants and researchers. Given that cognitive functioning in older adults tends to deteriorate as the day continues,[13] these inconsistencies in the timing of assessment could have produced unwanted variability in test scores.

Finally, in order to more definitively determine if the program is responsible for change, future studies should incorporate active control conditions (e.g., completing arts and crafts) that involve social and cognitive stimulation, but do not include activities that systematically target specific cognitive functions as was done in the cognitive training program.

Clinical Implications

- Activity staff in assisted living facilities and memory care units are often looking to develop novel and effective programming to address cognitive decline in their residents.
- The cognitive training program evaluated for this study may represent a viable form of alternative programming for promoting cognitive health in older adults who are experiencing cognitive decline.
- The program evaluated in this study is highly structured, manualized, comprehensive, and user-friendly for both participants as well as class facilitators.

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