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Influence Of A Short Exercise Program On Older Adults With Mild Cognitive Impairment

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Influence of a Short Exercise Program on Older Adults with Mild Cognitive Impairment

(TITLE)

BY

Kaori Mitsui

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Abstract

The influence of a 4-week exercise program on older adults with mild cognitive (MCI) impairment was measured in the study. Six older adults from a long-term care facility met the criteria for participation. After taking the Mini-Mental State Examination (MMSE), the participants were then randomly assigned to either an exercise group or a non-exercise group. All participants from the two groups attended a game of Bingo before and after the 4-week exercise program, and their positive and negative behaviors were recorded. Three participants in the exercise group participated in music-based physical exercise (a combination of chair-seated aerobic exercise and strength training) for 20 minutes each session. The other 3 participants did not exercise and all attended Bingo. After the last exercise session, all six participants took the MMSE again on the same day. A statistically significant increase in the mean MMSE score (25.3 to 27.3) of the exercise group was found compared to the non-exercise group. The observed positive and negative behaviors were also compared between the two groups, and the exercise group showed an increase in mean positive behaviors of 41.5 to 42.5 and a decrease in mean negative behaviors of .67 to 0. This study showed that older adults with MCI improved their cognitive functioning, increased their positive behaviors, and decreased negative behaviors followed by a 4-week exercise program.

Dedication

I dedicate this to my parents and brother who supported and encouraged me while working on this research project, and to my grandma whose presence inspired me to pursue this area of study.

Acknowledgements

I would like to thank my committee member, Dr. Phyllis Croisant, who provided me important information about physical exercise. Thank you very much, Dr. Kathleen O'Rourke. Without your understanding, I wouldn't be able to include behavioral analysis in my study. And thank you so much, Dr. Jeanne Snyder, for your advice and continuous support throughout this study. I also thank Dr. Ronald Petersen for giving me your permission to use a figure in my thesis. Lastly, I would like to thank Mrs. Henson, Andrea B., and Dr. Painter, all staff members, all participants, and the caregivers. Without your understanding and help, I wouldn't be able to complete my data collection. And thank you, Dr. Meadows for your help.

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Chapter 1

Introduction

As the world's population ages, the number of people with Alzheimer's disease (AD) is increasing. Except for Japan, the top 20 of the world's oldest countries are in Europe (Kinsella & Phillips, 2005). In many European countries, one-fifth of the population is age 65 or older. In the United States, one-eighth of the population is 65 or older; however, it will become one-fifth by 2030 (Kent, 2005). In fact, between the years 2000 to 2010, the population of people age 80 or older will increase by 50% in many countries, whereas the population of people age 65 and older will increase 24% (Kinsella & Phillips, 2005). The current estimation of people who are affected with AD is one in 10 people among older adults aged 65 and older, and half of those aged 85 or older (Ronald, 2005).

Alzheimer's disease is one type of dementia, and it is a gradual and progressive disease which destroys brain function and the mental health of older adults. Even though many risk factors have been identified as possible causes of AD, there is no one correct answer to the question of how AD develops in older individuals, and there is no cure for this memory deteriorating disease. However, mild cognitive impairment (MCI) has been studied and found to be linked to AD. Mild cognitive impairment can be converted to AD (Tierney, Herrmann, Geslani, & Szalai, 2003). Mild cognitive impairment is an unstable state, and studies have been done in this area to identify the very early signals of abnormality in the brain.

Studies of MCI and its relationship with AD and physical health have been increasing due to an increased population of older adults and concerns for their physical

and mental health. Declines in short-term memory detected by a variety of examinations have been determined as MCI. Although MCI can be defined and assessed in a variety of ways, the importance of detecting it does not change.

Effects of physical exercise on cognitive functioning in young and older individuals have also been studied. Participating in exercise is associated with better cognitive abilities compared to those without participating in any exercise. Relationships between exercise, disease, and cognitive abilities in healthy, sedentary, frail older adults have been studied, and positive outcomes resulting from exercise have been reported. Those who are physically fit are more cognitively highly functioning with better health than those who are less physically fit. Also, studies have shown that participating in physical exercise can not only reduce depressive symptoms and strengthen physical abilities, but also can prevent cognitive decline (Hillman, Belopolsky, Snook, Kramer, & McAuley, 2004; Kahatri et al., 2001).

Among older adults with MCI, physical exercise may be able to bring about the benefits found in the studies stated earlier. However, the influence of exercise on cognitive abilities of older adults with MCI is unknown.

Statement of Significance

In order to have a better understanding of cognitive decline in Alzheimer's disease patients, identifying early signs of memory decline become important, and MCI is one of the sign. Within one year, MCI can be reverted to normal, but the cause is unknown. If we have a better understanding on MCI, we can possibly identify its exact progressive development to AD. Also, we can provide a better treatment for those with MCI. Therefore, in this study, a combination of chair-seated aerobic exercise and

strength exercise was selected to be a controlled factor to stimulate the brain to see if there is any change in scores on a cognitive test as well as in behaviors. By incorporating the existing data of physical benefits gained from exercise, investigation of the relationships between MCI and the use of exercise as a treatment can lead to important discoveries.

Purpose of the Study

The purpose of this study was to investigate the effects of a 4-week exercise program on cognitive abilities, and on behavioral changes of mildly cognitively impaired older adults living in a long-term care facility.

Research Questions

1. Does a 4-week exercise program influence cognitive abilities of participants with MCI?
2. Does a 4-week exercise program influence behaviors of participants with MCI?

Research Objectives

1. To compare if the exercise group shows greater improvement on the Mini-Mental State Examination (MMSE) scores than the control group at the end of the 4-week exercise program.
2. To examine if a 4-week exercise program can increase positive behaviors and decrease negative behaviors in the exercise group.

Delimitations

There is no universally agreed upon definition for diagnosing MCI at present. The definition of MCI used in this study cannot be applied to all individuals with MCI.

Also, due to the limited sample size drawn from a specific area, the results can not be generalized to the whole population. Motivation of individuals who agree to participate in this study might influence the results. Mood and medication of older adults might influence their behaviors and cognitive abilities during the study, causing threats to internal and external validity.

Definition of Terms

The specific terms used in this study are defined as follows:

1. Older Adults: Individuals who are aged 60 or older (www.cla.ca/resources/olderadults.htm).
2. Mild Cognitive Impairment: Having three different types (amnestic [Scoring 25 to 28 out of 30 on the MMSE], single domain, and multiple domain), it is a prodromal state of dementia (Petersen, 2003).
3. Dementia: The prodromal states of multiple conditions: Alzheimer's disease, vascular dementia, frontotemporal dementia, Lewy body dementia, primary progressive aphasia, and depression (Petersen, 2003).
4. Alzheimer's disease: "Alzheimer's disease is a progressive brain disorder that gradually destroys a person's memory and ability to learn, reason, make judgments, communicate and carry out daily activities (www.alz.org/AboutAD/WhatIsAD.asp)."

Chapter 2

Literature Review

Many definitions have been used for mild cognitive impairment (MCI). According to Knopman, Boeve, and Petersen (2003), MCI is the intermediate zone between normal and dementia and does not impair daily functioning of individuals. It is also a precursor state of dementia or "...possible dementia prodrome, age-associated memory impairment, and age-associated cognitive impairment" (p. 1292). One of the common subtypes used in research is amnesic MCI. The progressive state of MCI is certainly different from normal aging, which is described by Petersen (1995) in Figure 1.

MCI and Early Detection

Studies have shown that a certain portion of MCI eventually converts to AD. In one study, 23% to 47% of MCI converted to dementia (Busse, Bischkopf, Riedel-Heller, & Angermeyer, 2003), and another study indicated that approximately 24% of older adults with MCI converted to AD within 2 years (Tierney et al., 2003). The risk of MCI converting to AD increases every year (Rinaldi et al., 2003), and Petersen (2004) stated that the progressive rate of MCI to AD is 10% to 15% per year. The more impaired the individuals with MCI, the more likely they are diagnosed with AD in the future (Knopman et al., 2003).

Although studies have identified the critical state to warn the subsequent stage of AD, other studies have pointed out important and optimistic facts about MCI. That is, not all people diagnosed as MCI will continuously experience deterioration of cognitive abilities. In two studies (Ritchie, Artero, & Touchon, 2001; Larrieu et al., 2002), data showed that subjects of MCI reverted to normal state. In the study of Larrieu et al.

(2002), they found that the reverting rate was 43.2% with subjects aged 65 or older at a 2nd year follow-up study. In another study, Ritchie et al. (2001) revealed that over 80% of the subjects aged 60 or older reverted to normal state by the second annual follow-up examinations.

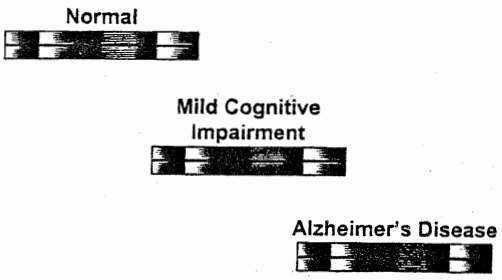

Figure 1. Transitional states of normal to mild cognitive impairment and Alzheimer's disease. [Adapted with permission from Petersen (1995).]

Objective Indication of Cognitive Decline

Inclusion of subjective memory complaints may not be necessary to obtain an accurate diagnosis of MCI because many individuals complain about their memory but they are actually healthy. Studies have shown the invalidity of using subjective memory complaints as a criterion for assessment of MCI. Small and La Rue (1995) found that self-appraisal of cognitive ability was not a predictor of change in individuals' cognition, according to mnemonic performance. Similarly, another study (Jungwirth, Fischer, Weissgram, Kirchmeyr, Bauer, & Tragl, 2004) showed that subjective memory complaints were not accurate to assess early stages of AD. These suggest that inclusion of subjective memory complaints may not increase the accuracy of detecting the very early stage of cognitive decline.

Mini-Mental State Examination

The Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) has been widely used for screening cognitive abilities of older adults. The MMSE

shows its average of sensitivity of 83%, and specificity of 83% for detecting cognitive impairment (Bland & Newman, 2001). Although there are studies indicating cut-off scores for detecting MCI (Busse, et al, 2003), Petersen (2003) stated that scoring 25 to 28 on the MMSE should be applied to all older adults as amnestic mild cognitive impairment.

Poor Health and Cognitive Decline

Depression, cerebrovascular disease, and physical disabilities are more likely to be found in MCI individuals. MCI in older individuals is considered to be associated with poor health (Frisoni, Fratiglioni, & Johan, 2000), high level of a depressive state, and an increase in further cognitive decline (Chi & Chou, 2000). In another study, Frisoni et al. (2000) conducted a study to investigate the relationship between MCI and physical health in older adults, and found that the prevalence of MCI among most age strata was 11% to 19%. Among their participants, more MCI individuals were found to rate poorer in five somatic symptoms (heart discomfort, shortness of breath, difficulty in digesting, joint pain, and poor appetite) and three chronic diseases (diabetes mellitus, coronary heart disease, and cancer) than non-MCI individuals.

Exercise Maintains Physical and Psychological Health

To maintain physical health and mental health, older adults need to engage in regular exercise. By participating in sports (i.e., running, racket sports), older adults were found to be as competent as young active people and superior to young non-active people in physical abilities (Spirduso & Clifford, 1978). According to Pate et al. (1995), the Centers for Disease Control and Prevention and the American College of Sports Medicine recommended that all adults need to engage in 30 minutes or more of physical activity with moderate intensity on most, or all days, of each week. A physical activity of

moderate intensity can be brisk walking. More importantly, a 30-minute long exercise can be done in three 10-minute exercise sessions at any time during a day.

Not only can physically fit, healthy, older adults obtain health benefits, but sedentary older adults can also improve their physical and mental health. For example, moderate-intensity physical activity was found to increase plasma high-density lipoprotein cholesterol (HDL-C) (King, Haskell, Oka, & Stefanick, 1995). Li, McAuley, Harmer, Duncan, and Chaumeton (2001) found that Tai Chi was able to enhance self-efficacy and exercise participation among low-active older adults. Frail older adults can also gain health benefits by starting with low-intensity exercise and increasing the intensity gradually (Barry, Rich, & Carlso, 1993).

Exercise and Cognitive Decline

There have been studies showing possible prevention of cognitive decline by participating in exercise. Among healthy older adults, studies showed that higher physical activity is associated with higher cognitive abilities (Barnes, Yaffe, Satariano, & Tager, 2003; Clarkson-Smith & Hartley, 1989; Clarkson-Smith & Hartley, 1990; DiPietro, Seeman, Merrill & Berkman, 1996). Also, physically fit adults, aged 55 to 79, showed less age-related brain-tissue shrinkage, in the part where cell communication, memory, and learning happen, than less active participants (Harvard Women's Health Watch, 2003). Moderate to high physical activity was found to possibly prevent cognitive decline in older adults (Hillman et al., 2004). Another study revealed that all levels of regular exercise were able to reduce the chance of getting cognitive impairment without dementia (CIND), AD, and other types of dementia except vascular dementia (Malott, 2001).

Aerobic Exercise and Strength Training

Studies have shown that aerobic exercise and strength training are effective for improving cognition. Participation in aerobic exercise among healthy older adults showed improvement in their cognitive performance by 15 to 20 percent (Willdorf, 2001). Even one session of mild exercise introduced to cognitively unimpaired, institutionalized sedentary older adults showed memory improvement in the experimental group, but not in the control group (Dawe & Moore-Orr, 1995).

More importantly, Colombe and Kramer (2003) found that a combination of strength and aerobic exercise resulted in a greater effect on the cognition of people aged 55 to 80 compared to aerobic exercise only. Their findings suggested that sedentary older adults assigned to the exercise group gained the most benefit in their executive control processes such as planning, inhibition, and working memory which are abilities in the brain most vulnerable to aging. Also, data indicated that the younger the participants are and the more time the participants spent exercising, the greater improvement in cognition they gain.

Two other studies also found positive correlations between time spent exercising and memory (Rebok & Plude, 2001; Woo & Sharps, 2003). In another study, according to Harvard Women's Health Watch (2003), aerobic fitness training showed its benefits on cognitive ability (executive control functioning) in women and men aged 55 to 80, and the use of combination with strength training showed further effectiveness.

Exercise Habits of Men and Women

One study found that men and women have similar attitudes towards exercise (Schuler, Richardson, Ochoa, & Wang, 2001). According to answers given to a survey

and physical diary of 56 participants aged from 56 to 86, Schuler et al. (2001) revealed that men and women were similar in all measured categories: individual's average activity level (MET per minute per day), total time (hours per week), total energy expenditure (kilogram calorie per week), and total activity summary (vigorous activity, leisure walking, moving, standing, and sitting). Less than 25% of older adults, however, were engaged in any regular physical activity (Powell, Spain, Christenson, & Mollenkamp, 1986; Parks & Recreation, 2003). These data indicate that males and females in their old ages prefer the same kinds of physical activities, spend the same amount of time exercising, and that many older adults do not engage in any regular exercise that could jeopardize their physical and mental health.

Outcomes of Exercise and Older Adults with Diseases

Many studies have indicated that physical activities produce positive physical and mental outcomes for patients with Parkinson's disease (Reuter, Engelhardt, Stecker, & Baas, 1999), depression (Khatri, et al., 2001), and Alzheimer's disease (Brawley, 2004; Poser & Ronthal, 1991; Wellbery, 2004). Reuter et al. (1999) implemented various sports activities for 1 hour twice a week to 16 participants with Parkinson's disease (PD). Fourteen weeks later, they found that the participants' motor disabilities were significantly decreased, and subjective well-being was clearly improved. Another study (Khatri et al., 2001) compared 84 clinically depressed participants between medication use only and a combination of exercise and medication use. After 4 months, they found that the exercise group significantly improved peak VO_2, and significantly decreased in depressive symptoms. Also, the participants' memory (delayed and immediate recall) and executive functioning were greatly improved.

Brawley (2004), and Poser and Ronthal (1991) suggested that any physical activities (from gardening to skating) which AD patients can manage could slow further decline and maintain physical and mental health. The study of Teri et al. (2003) also supported the benefits brought by exercise in AD patients. She notes that 140 community-dwelling AD patients aged 55 to 93 were able to complete moderate-intensity exercise for at least 30 minutes, and the exercise group showed significant improvement in physical health and depressive symptoms at 3 months. Twenty-four months later, the exercisers who completed the follow-up study showed their significant physical and mental improvement are still remained.

Exercise and Cognitively Impaired Participants

Studies have pointed out that regular exercise works as a preventive for cognitive decline and treatment for diseases, and it is possible for Alzheimer's patients to participate in an exercise program for health benefits despite the presence of their cognitive impairment (Arkin, 1999; Binder, 1995; Chapman & Osterweil, 2001; Tappen, Roach, Buchner, Barry, & Edelstein, 1997). Music was found to be a useful tool when people with AD engaged in exercise (Groene, Zapchenk, Marble, & Kantar, 1998; Lord &Garner, 1993). Winckel, Feys, and Weerdt (2004) studied 15 demented patients who participated in music-based exercise for 3 months. The MMSE was given to them after 6 weeks and 3 months, and the mean MMSE scores showed increases from 12.87 to 14.40, and 15.53. However, no study has examined the impacts of physical exercise on older adults with MCI.

Summary

Mild cognitive impairment has been identified as a possible precursor state to AD. Since MCI will not progress to AD in every case, it is considered an unstable state. What influences this state to revert to normal within a year is unclear. To screen the change in cognition, the MMSE has been widely used in practical and clinical settings.

Many studies have proven that physical exercise can improve cognitive functioning and psychological well-being, and physical strength among cognitively healthy older adults; however, the majority of older adults do not engage in any regular physical activity. By performing a combination of aerobic exercise and strength training, older adults can gain more health benefits than those who performed only aerobic exercise. Older adults with PD and AD can also obtain health benefits by doing physical exercise.

By participating in a routine exercise, AD patients showed significant improvement in physical health and depressive symptoms. In addition to that, the use of music is practical and beneficial when introducing exercise to demented patients and AD patients. In fact, one study showed that music-based exercise provided cognitive improvement among demented patients. But the influence of physical exercise associated with MCI is not known.

Chapter 3

Methodology

The purpose of this study was to investigate the influence of a 4-week exercise program on cognitive abilities and on behaviors of mildly cognitively impaired older adults living in a long-term care facility. Participants in the study scored 25 to 28 on the MMSE at baseline, and were randomly assigned to an experimental and a control group. Before the 4-week exercise program started, both groups attended a game of Bingo, where their behaviors were video taped as a group for 20 minutes. Then the experimental group (the exercise group) participated in a 20-minute chair-seated aerobic and strength exercise 3 days per week for 4 weeks. During the 4 weeks, the control group (the non-exercise group) did not engage in the exercise program. At the end of 4 weeks, both groups took the MMSE again on the same day of last exercise session. Then both groups attended a game of Bingo again within 3 days from taking the second MMSE. At the game, they were seated in the same location, and once again their behaviors as a group were video taped for 20 minutes. To answer the research questions, the study was carried out based on two specific objectives:

Research Questions

1. Does a 4-week exercise program influence cognitive abilities of participants with MCI?
2. Does a 4-week exercise program influence behaviors of participants with MCI?

Research Objectives

1. To compare if the exercise group shows greater improvement on the MMSE scores than the control group at the end of the 4-week exercise program.
2. To examine if a 4-week exercise program can increase positive behaviors and decrease negative behaviors in the exercise group.

Research Design

Using a case study approach, an experimental design with purposive sampling was employed, followed by descriptive data analysis. The participants were randomly assigned into either an experimental group (the exercisers) or a control group (the non-exercisers). In this study, quantitative and qualitative data were gathered from both groups through the MMSE and an observer rating sheet.

Subjects

There were seven inclusion criteria for subjects in this study. First, participants needed to be age 60 or older. Second, participants fell into the categories of mild to severe cognitive impairment on a cognitive test (Mini Mental State Examination modified specifically for the residents) when they entered the facility. Third, caregiver/family member's consent (see Appendix C) had to be obtained. Fourth, verbal agreement by the older adults was needed. Fifth, score 25 to 28 on the MMSE at baseline was required, which was obtained after having verbal consent from the older adults. Sixth, the participants who scored 25 to 28 on the MMSE had to be physically capable of performing the chair-seated aerobic exercise and strength training. Last, a physician's permission for the types of exercises described in the study was required. Then the

participants were randomly assigned into either the experimental group (the exercise group) or the control group (the non-exercise group).

Data Collection Instruments

Two data collection instruments were used in the study. One instrument was the MMSE (see Appendix A) which was used to measure cognitive abilities of all participants before and after the 4-week exercise program. The other one was the observer rating sheet (see Appendix B) which was used to count the frequency of 12 specific behaviors of all participants when they were participating in a game of Bingo. Their behaviors were video taped as a group twice (20 minutes each), before and after the 4-week exercise program.

Mini-Mental State Examination. The MMSE (Folstein et al., 1975) is widely used to assess and screen cognitive impairment (i.e., mild, moderate, and severe cognitive impairment). A score of 25 to 28 out of 30, according to Petersen (2003), is used for detecting amnestic mild cognitive impairment. This scoring range was applied to this study. The MMSE has five categories:

1. Orientation: 1) year, season, date, day, month; 2) state, country, city, facility, floor
2. Registration: sky, table, red.
3. Attention and calculation: d_l_r_o_w
4. Recall: the 3 words.
5. Language: 1) name pencil and watch; 2) No ifs, ands, or buts; 3) "take a paper in your right hand, fold it in half, and put it on the floor"; 4) "CLOSE YOUR EYES"; 5) write a spontaneous sentence; 6) copy two intersected pentagons.

The MMSE sensitivity is 83%, and specificity is 83% to detect cognitive impairment. The MMSE has shown its validity from a clinical point of view. Also, as an instrument, the MMSE is reliable shown in retest within 24 hours or 28 days administered by the same or different examiners, which shows the practice effect is small.

Observer rating sheet. The observation recording sheet (see Appendix B) was used after videotaping. The older adults participating in a game of Bingo which was an activity determined to be familiar to them. Also, interactions of older adults with one another as well as with staff members and the researcher could be observed during the game. This activity was done twice, before and after the 4-week exercise program. Behaviors of all older adults playing Bingo were determined based on 12 categories (O'Rourke, 1999). The first eight behaviors were considered to be positive behaviors, and the other four were considered to be negative behaviors. The measurement was adapted from a study by O'Rourke (1999) to observe behaviors of older adults participating in art activities with children. Validity and reliability of the rating have not been established.

Modified behavioral variables are defined below:

1. Responds to peers, an instructor, or staff: verbally or physically (e.g., nodding head) acknowledging question, statement, or request.
2. Talks spontaneously to peers, an instructor, or staff: verbally communicating without prompting (e.g., question, request).
3. Offers help to peers, an instructor, or staff: providing verbal or physical assistance or encouragement during an activity (e.g., passing equipment or materials to others).

4. Participates in activity: physically contributing to the process of the activity (e.g., participating in each game after "Bingo!" is called).

5. Looks at peers, an instructor, or staff: turning head toward peers, an instructor, or stuff with eyes focused somewhere between the top of the head and feet.

6. Smiles: a crease showing on the cheek, and corners of mouth turning upward; teeth may or may not be shown.

7. Appropriately touches peers, an instructor, or staff: making physical contact (e.g., hugging, placing arms around shoulder, holding hand, patting back).

8. Laughs: a crease showing on the cheek and corners of mouth turning upward with chuckling or giggling in amusement; teeth may or may not be shown.

9. Withdraws from activity: ceasing all physical interactions with peers, an instructor, staff, or the activity.

10. Displays agitation: physically appearing upset or disturbed (e.g., look of disgust).

11. Displays anxiety: physically showing concern, fear, repetitive nervous actions (e.g., holding head in hand, squeezing hands).

12. Displays aggression or other inappropriate behavior: intending to cause psychological or physical harm to a person or object (e.g., pushing or pulling hand away, hitting, kicking, biting, using foul language, throwing things).

Procedure of Data Collection

At pre-treatment, after obtaining caregivers/family members' written consent and verbal consent of older adults, the MMSE was given to each older adult by a staff member of the facility. Older adults who met the inclusion criteria were randomly assigned to the exercise group or the non-exercise group. Both groups attended a game

of Bingo, and their behaviors as a group were video taped for 20 minutes. The exercise group engaged in a combination of chair-seated aerobic exercise (15 minutes) and strength training (5 minutes) 3 days per week for 4 weeks. The non-exercise group did not participate in the exercise program during the 4 weeks. After the last exercise session, the MMSE was administered to all participants by the same staff on the same day. Within 3 days from the last exercise session, all participants attended a game of Bingo, and their behaviors as a group were video taped for 20 minutes again.

Pre-treatment. Of the seven older adults, the MMSE was administered individually by the social service personnel, and six scored 25 to 28 and were allowed to do the chair seated exercises. The 6 participants were randomly assigned to either the exercise or non-exercise group. All six individuals participated in a game of Bingo which was an activity familiar to them. Their behaviors as a group were videotaped for 20 minutes.

Treatment. The Experimental Group Those who were in the experimental group engaged in a combination of chair-seated aerobic exercise (15 minutes) and strength training (5 minutes), beginning with warming up for 5 minutes and ending with cooling down for 5 minutes. The exercise group participated 3 days per week for 4 weeks.

A CD, "Big Band Swing" (Bee, 1998), was played after all exercisers were seated in a chair and ready to begin. First, the investigator sat in a chair in front of the exercisers to instruct them to do 5-minute warming up. Next, they started the chair-seated aerobic exercises. Movements involved in the chair-seated aerobic exercise were: moving shoulders, arms, wrists, fingers, head, stomach, waist, legs, ankles, and hips (see Appendix D). Every movement described in Appendix D was done 10 times each.

After the chair-seated aerobic exercise, the instructor provided a water bottle (.5L, approximately one lb.) to the exercisers, and they spent 5 minutes performing strength training. Each one held a water bottle in their hand and performed upper body strength exercises (see Appendix E). The movements were performed 10 times, starting from their right hand then shifting to their left hand. After strength training, they spent approximately 5 minutes cooling down and resting before they stood up and left the room. They participated in a familiar activity, Bingo, before and after the 4-week exercise program. Their behaviors were video taped as a group (with the control group) for 20 minutes once during the game.

The Control Group The participants in the non-exercise group didn't engage in any exercise during the 4 weeks. However, the MMSE was administered at the beginning of the study and then again on the last day of the exercise program. Additionally, they played Bingo with the exercise group once more as they did before. On the same day of a week (Monday) and at the same time (6:30 p.m.), the participants were gathered in the same room to play Bingo. They seated at the same place, and they were video taped with the other group for 20 minutes once from the same angle (see Appendix F).

Post-treatment. On the last day of the exercise program, both groups took the MMSE again. All six participants took the examination on the same day after the last exercise session ended. Then, all participants from both groups played Bingo again within 3 days, and their behaviors as a group were videotaped for 20 minutes.

Data Analysis

Mean scores and standard deviations of the demographic data, the MMSE, frequencies of behaviors of the two groups were reported and compared. Also, an independent-sample *t* test (one-tailed) was performed to determine if there was a difference in amount of MMSE change between the exercise and control group. Tables were used to categorize data for the purpose of comparing the exercise and non-exercise group. For the participants in the exercise group, the number of sessions completed in the 4-week exercise program was reported. Qualitative data based on the researcher's observations was used for data analysis as well.

Summary

Based on the two research questions, the two research objectives were addressed to guide data collection. Research design of the study was using a case study approach and an experimental design with purposive sampling. Participants were all from one long-term care facility, and met seven inclusion criteria. In the study, the MMSE and the observer rating sheet were the two data collection instruments used to measure cognitive abilities and to count the frequency of 12 behaviors of all participants. An independent-sample *t* test (one-tailed), mean scores, standard deviations, and tables as well as qualitative data gathered at pre-treatment, treatment, and post-treatment were used for data analysis.

Chapter 4

Results and Discussion

The purpose of this study was to investigate the effects of a 4-week exercise program on cognitive abilities, and on behavioral changes of mildly cognitively impaired older adults living in a long-term care facility. To answer the research questions, the study was carried out based on two specific objectives:

Research Questions

1. Does a 4-week exercise program influence cognitive abilities of participants with MCI?
2. Does a 4-week exercise program influence behaviors of participants with MCI?

Research Objectives

1. To compare if the exercise group shows greater improvement on the MMSE scores than the control group at the end of the 4-week exercise program.
2. To examine if a 4-week exercise program can increase positive behaviors and decrease negative behaviors in the exercise group.

Sample Analysis

Of the 14 consent forms mailed to caregivers/family members of prospective participants, 10 forms were returned. Two of the caregivers/ family members did not give consent for their care receivers to participate in the study. Among eight prospective participants, one was hospitalized, and another one was not able to meet inclusion criteria. The remaining six older adults consisted of one male and five females. They were already permitted by a physician to do a combination of chair-seated aerobic exercise and

strength training. By randomly drawing three numbers from a bowl, three females were chosen to be in the exercise group, and the remaining three were assigned to the non-exercise group. Table 1 shows the demographic data of all 6 participants.

Table 1

Demographic Data of Individuals

Group	Age	Gender	Length of Stay (month)
Exercisers			
1 w	97	Female	19
2 w	95	Female	30
3 c e	90	Female	29
Non-Exercisers			
1 c	87	Female	60
2 c e	88	Male	1
3 w	89	Female	5

w Participant using a walker
c Participant using a wheelchair
e Participant with visual impairment

Exercise group. As Table 1 shows, all participants in this group were in their 90s. The mean age was 94.0 (*SD*= 3.60) year-old, and length of stay at the facility was 26.0 (*SD*= 6.08) months. They were either using a walker or a wheelchair, and one of them had eyesight impairment.

Exerciser 1 This participant was female, and was 97 years of age. Her length of stay at the long-term care facility was 19 months. She was using a walker in the facility.

Exerciser 2 This participant was female, and her age was 95. Her length of stay at the long-term care facility was 30 months. She was also using a walker at the facility.

Exerciser 3 This participant was also female and was 90 years of age. Her length of stay at the long-term care facility was 29 months. She was in a wheelchair at the facility. She had a visual problem which made it difficult for her to identify the numbers on the Bingo board.

Non-exercise group. One participant was male, and the other two were females in this group. As a group, the mean age was 88.0 (*SD*= 1.0) and the mean length of stay was 22.0 (*SD*= 32.97) months. One participant was using a walker. The other two participants were in a wheelchair, and one of them had visual impairment.

Non-exerciser 1 This participant was female, and she was 87 years old. Her length of stay at the long-term care facility was 60 months. She was using a wheelchair for mobility.

Non-exerciser 2 This participant was male, and was 88 years of age. His length of stay at the facility was 1 month. He was using a wheelchair as his mobility and had a visual problem which made it difficult for him to identify the numbers on the Bingo board.

Non-exerciser 3 This participant was female, and her age was 89 years old. Her length of stay at the long-term care facility was 5 months. As her mobility, she was using a walker.

As Table 2 shows, the mean age of the exercise group was 94 and the non-exercise group was 88. The length of stay for the exercise group was 26 (*SD*= 6.08) months and the non-exercise group was 22 (*SD*= 39.97) months. This indicated that the exercise group was older and had stayed in the facility longer than the non-exercise group.

Table 2

Mean Scores and Standard Deviations of Demographic Data of Two Groups

	Age		Length of Stay (month)	
	M	*SD*	*M*	*SD*
Exerciser Group	94.0	3.60	26.0	6.08
Non-Exercise Group	88.0	1.0	22.0	32.97

As noted in Table 1, 3 participants were using a walker, and the rest of the 3 participants were in a wheelchair. Exerciser 3 and Non-exerciser 2 had vision problems, which caused them to have trouble seeing the numbers on the Bingo board. Each group had at least one participant with a walker, wheelchair, and visual impairment, which made the two groups relatively equal in their physical conditions. All 6 participants took the MMSE at pre- and post-treatment, and played a game of Bingo before and after the 4-week exercise program, except Exerciser 2 who did not attend the game at the end of 4 weeks.

Analysis of the MMSE Scores

All 6 participants in the study took the MMSE before and after the 4-week exercise program. As Table 3 shows, there were four individuals who scored greater at post-treatment than at pre-treatment. One scored the same, and another one scored lower than the score at pre-treatment.

Exerciser 1 She scored 26 out of 30 on the MMSE at baseline. After the 4-week exercise program, she scored 28 on the MMSE. When comparing the score at pre-treatment with the score at post-treatment, the score at post-treatment increased by 2

points. Although she lost 1 point at "Orientation: state, country, city, facility, floor", she gained 3 points at "Orientation: year, season, date, day, month", "Recall: sky, table, red", and "Write a spontaneous sentence". She did not write anything at "Write a spontaneous sentence" before the 4-week exercise program; however, she wrote "I like candy." at post treatment.

Table 3

The MMSE Scores of Individuals

	MMSE	
Group	Pre-treatment	Post-treatment
Exercisers		
1 w	26	28
2 w	25	28
3 c e	25	26
Non-Exercisers		
1 c	28	29
2 c e	25	24
3 w	26	26

w Participant using a walker
c Participant using a wheelchair
e Participant with visual impairment

Exerciser 2 She scored 25 out of 30 on the MMSE at baseline. After participating in music based exercise for 4 weeks, she scored 28 on the MMSE. When comparing the two scores at pre- and post-treatment, her score at post-treatment showed an increase of 3 points. She gained the 3 points at "Orientation: year, season, date, day, month", "Language: name a pencil and watch", and "Copy two intersected pentagons". She did not draw the pentagons at all at pre-treatment, but she drew two intersected pentagons after the 4-week exercise program.

Exerciser 3 She scored 25 out of 30 on the MMSE at baseline. After participating in the music based exercise for 4 weeks, she scored 26 on the MMSE. When comparing the two scores at pre- and post-treatment, the score at post-treatment showed an increase of 1 point. She increased the 1 point at "Orientation: year, season, date, day, month".

Non-exerciser 1 She scored 28 out of 30 on the MMSE at baseline. Four weeks later, she scored 29 on the MMSE. Her test score at post-treatment showed an increase of 1 point. She gained 2 points at "Orientation: year, season, month, date, day" and "Language: name a pencil and watch", but she lost 1 point at "Orientation: state, country, city, facility, floor".

Non-exerciser 2 He scored 25 out of 30 on the MMSE at baseline. After 4 weeks, he scored 24 on the MMSE. His score decreased by 1 point from pre-treatment. He gained 1 point at "Language: name a pencil and watch", but he lost 2 points at "Orientation: year, season, month, date, day" and "Orientation: state, country, city, facility, floor".

Non-exerciser 3 She scored 26 out of 30 on the MMSE at baseline. Four weeks later, she scored 26 again on the MMSE. At post-treatment, she gained 2 points at "Orientation: year season, month, date, day" and "Language: name a pencil and watch", and lost 2 points at "Registration: sky, table, red" and "Recall: sky, table, red".

Comparing the MMSE scores of two groups. As Table 4 illustrates, the mean MMSE score of the exercise group before the 4-week exercise program was 25.3 (*SD*= .58). The mean sore of this group after the 4-week exercise program was 27.3 (*SD*= 1.16). All three participants improved their test scores at post-treatment. The mean

MMSE score of the non-exercise group at baseline was 26.3 (*SD*= 1.52). After 4 weeks, the mean MMSE score of this group was 26.3 (*SD*= 2.52).

After the 4-week exercise program, the mean MMSE score of the exercise group

Table 4

Mean Scores and Standard Deviations of the MMSE of Two Groups

	Pre-treatment		Post-treatment	
	M	*SD*	*M*	*SD*
Exerciser Group	25.3	.58	27.3	1.16
Non-Exercise Group	26.3	1.52	26.3	2.52

increased by 2 points whereas the mean MMSE score of the non-exercise group remained the same. This change of the MMSE scores was compared by an independent-sample *t* test (one-tailed). The result revealed that there was a statistically significant increase ($t(4)= 2.45$, $p< .05$) in the MMSE scores in the exercise group compared to the control group.

One similarity stands out regarding the improvement in the MMSE scores of the exercisers. All three exercisers gained 1 point at "Orientation: year, season, date, day, month". It may be that participating in the exercise program 3 days per week (Tuesday, Wednesday, and Thursday [except last week was Friday]) for 4 weeks helped participants remember the specific day, date, season, month, or year. Unlike the exercise group, all 3 participants in the non-exercise group gained 1 point at "Language: name a pencil and watch" though, no specific explanation could be given to this result.

When comparing the points gained and lost in the two groups, another fact was revealed. That is, in the exercise group, only Exerciser 1 lost one point, and the other two

exercisers did not lose any points compared to their own score at pre-treatment. Contrary to this fact found in the exercisers, all non-exercisers showed a one- or two-point loss.

Behavior Analysis

All 3 participants assigned to the exercise group attended a game of Bingo at pre-treatment, but one was absent at post-treatment. All 3 participants assigned to the non-exercise group participated in Bingo at pre- and post-treatment. Their behaviors at the game were video taped as a group for 20 minutes at pre-treatment, and once again at post-treatment. Each individual's positive and negative behaviors were shown in Table 5.

Table 5

Positive and Negative Behaviors of Two Groups

	Positive Behaviors		Negative Behaviors	
Group	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Exercisers				
1 w	49	57	2	0
2 w	106	—	0	—
3 c e	34	28	0	0
Non-Exerciser				
1 c	95	76	0	0
2 c e	42	52	0	0
3 w	105	85	0	0

w Participant using a walker
c Participant using a wheelchair
e Participant with eyesight impairment

Exerciser 1 The frequency of her positive behaviors at pre-treatment was 49, and at post-treatment was 57. The number of the positive behaviors at pre-treatment was seen

in "Responds to others (once)", "Talks spontaneously to others (3 times)", "Participates in activity (6 times)", "Looks at others (38 times)", and "Smiles (once)". The number of the positive behaviors at post-treatment was seen in "Responds to others (once)", "Talks spontaneously to others (4 times)", "Participates in activity (6 times)", and "Looks at others (46 times)". Although there was no "Smiles" was observed at post-treatment, the frequencies of her behavior in "Talks spontaneously to others" and "Looks at others" increased by once and 8 times. The frequencies of "Responds to others" and "Participates in activity" stayed the same. Her negative behaviors at pre-treatment were observed twice. It was when she once called "Bingo," the staff member pointed out to her that she did not clear the board when it was needed to, and she held her head with her hand. On contrary to her negative behaviors at pre-treatment, she was alert and did not show any negative behaviors at post-treatment.

Exerciser 2 The occurrence of her positive behaviors was 106 times and she did not show any negative behaviors at pre-treatment. She was not able to participate in Bingo at post-treatment because she was not feeling well. The number of the positive behaviors at pre-treatment was seen in her "Responds to others (2 times)", "Participates in activity (6 times)", and "Looks at others (98 times)".

Exerciser 3 The number of her positive behaviors at pre-treatment was 34, and at post-treatment was 28. Her positive behaviors at pre-treatment were seen in "Responds to others (once)", "Talks spontaneously to others (3 times)", "Looks at others (27 times)", and "Smiles (3 times)". At post-treatment, her positive behaviors were observed in "Talks spontaneously to others (4 times) and "Looks at others (24 times)". At post-treatment, she did not show any "Responds to others" and "Smiles", and showed a

decreased number of "Looks at others" by 3 times; however, a number of "Talks spontaneously to others" were increased by one. Even though she was not able to play the game like other participants due to her visual impairment, she did not try to leave the room or the table during the game. She was telling others that she was not able to see the numbers, but she was trying to see the numbers on the Bingo board at pre- and post-treatment. She displayed spontaneous talks and smiles to Exerciser 2 and looked at her often at pre-treatment; however, since Exerciser 2 couldn't attend a game of Bingo at post-treatment, Exerciser 3 tried to talk to the staff who was far from her and mainly looked at the way of Exerciser 1, the camera (the researcher), and the window. Another change seen in this participant's behavior was that she leaned forward and tried to look at the numbers on the board at pre-treatment, but at the next game after 4 weeks, she used her hand to bring the Bingo board close to her and tried to see the numbers by adjusting the distance and light effect.

Non-Exerciser 1 Her positive behaviors at pre-treatment were observed 95 times, and at post-treatment, 76 times. Her positive behaviors were seen in "Responds to others (5 times)", "Talks spontaneously to others (7 times)", "Participates in activity (6 times)", "Looks at others (53 times)", "Smiles (22 times)", and "Laughs (2 times)". At post-treatment, her positive behaviors were seen in "Responds to others (7 times)", "Talks spontaneously to others (7 times)", "Participates in activity (6 times)", "Looks at others (53 times)", "Smiles (2 times)", and "Laughs (once)". The number of "Responds to others" was increased by twice, and the number of the "Talks spontaneously to others", "Participates in activity", and "Looks at others" stayed the same. The frequencies of

"Smiles" and "Laughs", however, decreased by 20 and 1, respectively. She did not display any negative behaviors at pre- and post-treatment.

Non-exerciser 2 The number of positive behaviors at pre-treatment was 42, and at post-treatment was 52. The frequencies of his positive behaviors at pre-treatment were seen in "Responds to others (once)", "Participates in activity (6 times)", and "Looks at others (35 times)". At post-treatment, his positive behaviors were seen in "Responds to others (once)", "Participates in activity (once)", and "Looks at others (50 times)". He displayed the same types of positive behaviors, and the frequencies of "Looks at others" increased by 15 times. Although he was checking the Bingo boards, whether or not he was checking the right number was unknown because he had visual impairment. He did not display any negative behaviors at pre- and post-treatment.

Non-exerciser 3 The frequencies of her positive behaviors were 105 at pre-treatment, and were 85 at post-treatment. Her positive behaviors at pre-treatment were seen in "Responds to others (once)", "Talks spontaneously to others (10 times)", "Offers help to others (2 times)", "Participates in activity (6 times)", "Looks at others (82 times)", "Smiles (3 times)", and "Laughs (once)". At post-treatment, her positive behaviors were seen in "Responds to others (once)", "Talks spontaneously to others (7 times)", "Participates in activity (6 times)", "Looks at others (70 times)", and "Laughs (once)". The frequencies of "Responds to others", "Participates in activity", and "Laughs" at post-treatment were the same as that seen at pre-treatment. The frequencies of "Talks spontaneously to others" and "Looks at others" decreased by 3 and 12 times at post-treatment. She displayed "Offers help to others" and "Smiles" at pre-treatment, but she did not show any of these two behaviors at post-treatment.

Also, she displayed some other behavioral changes at post-treatment. Before the game began, she was showing her concerns about where to sit, although it was the same place offered to her at pre-treatment. In addition to that, she kept asking what number was called, and did the board need to be cleared out, and that was not seen 4 weeks before.

Comparing Behaviors of Two Groups

The observed mean positive and negative behaviors of the two groups are illustrated in Table 6. The mean positive behaviors of the exercise group at pre-treatment was 41.5 (*SD*= 10.61), by excluding one participant who did not attend a game of Bingo at post-treatment. After the 4-week exercise program, the mean positive behaviors was 42.5 (*SD*= 20.51). There was an increase of 1 point in the mean positive behaviors. The mean negative behaviors at pre-treatment was .67 (*SD*= 1.16), and at post-treatment was 0. During the game of Bingo at pre- and post-treatment, there were five calls for "Bingo!"

Table 6

Mean Scores of Behaviors of Two Groups

	Positive Behaviors				Negative Behaviors			
	Pre-treatment		Post-treatment		Pre-treatment		Post-treatment	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Exercise Group	41.5*	10.61	42.5	20.51	.67	1.16	0	0
Non-Exercise Group	80.7	33.86	71.0	17.06	0	0	0	0

* mean score excluded exerciser 2

The mean positive behaviors of the non-exercise group at pre-treatment was 80.7 (*SD*= 33.86). Four weeks later, the mean positive behaviors was 71.0 (*SD*= 17.06). The mean positive behaviors at post-treatment showed a decrease of 9.7. In this group, negative behaviors were not observed at pre- and post-treatment. There were five calls for "Bingo" during the game at pre- and post-treatment.

The results indicated that after the 4-week exercise program, the mean positive behavior of the exercise group was increased, on the other hand, the mean positive behavior of the non-exercise group decreased. Before the 4-week exercise started, there were 2 negative behaviors observed in the exercise group; however, there were no negative behaviors observed in this group followed by the 4-week exercise program. In the non-exercise group, there was no negative behavior observed at pre- and post-treatment, so the frequency of negative behaviors remained the same.

Observations during the Exercise Program

Participants in this group showed enjoyment towards the music played during the exercise. By week 3, all three participants came to follow the researcher's movements much more than in the beginning. At the end of the third week and during the fourth week, there was laughter. When comparing the first attended session to the last attended session, there were notable changes. Also, verbal and non-verbal exchanges between the participants and the researcher indicated positive influences of music based exercise program for 4 weeks. The number of exercise sessions which each older adult missed was due to physical and psychological reasons as well as family visits.

Exerciser 1 She completed 10 exercise sessions out of 12 sessions. During the first week of the 4-week exercise program, she hardly moved her arms up especially her right arm, and she would say, "It won't do that." During the second week, she left for bathroom 5 minutes after the exercise started, and she did not come back at all. According to one of the staff members of the facility, it was one example of her excuses to escape from what she was not so fond of. During third week of the exercise program, she would make sounds "Oh, oh, oh, oh," but she would try to move her arms up, so the researcher told her, "Oh, don't try too hard." She was probably trying to do the same movement as the other two participants were doing because she was looking at them some times, and they were following the researcher's instruction for exercising. At the last attended session, she was able to hold her hands and move them up, and smiled at the researcher beneath her hands.

Exerciser 2 She completed 8 exercise sessions out of 12 sessions. She showed her enjoyment towards the music from the beginning of the exercise program. She moved her hands and feet rhythmically to the music. During the first two weeks, she had to stop one movement and observe the next movement of which the researcher was doing in order to follow. Also, she had to stop for a while and take a rest during the exercise sessions. At week 3, she knew that she had to do all movements which the researcher was doing, so she kept moving. At one session, while doing "Make steps" she used her hands to lift her legs up. She probably thought that she was not making as big step as the researcher was making, so she tried to do the same. Regarding this behavior, the researcher and the other two participants looked at her, and Exerciser 1 said to her, "That helps." Then Exerciser 2 smiled and laughed, and the researcher and other two

participants smiled and laughed as well. Unlike the first attended session, she was able to keep moving with the music at the last attended session although she was not following the exact movements.

Exerciser 3 She completed 10 exercise sessions out of 12 sessions. She also showed her enjoyment towards the music from the beginning. At week 1, when the researcher and this participant were looking at the garden from the window before starting the exercises, the researcher pointed out that there was a cute little bird, but she said, "I can't see that." Also, she told the researcher that she liked the feature of the garden, and she was not able to tell the objects flying through the garden were birds. During the third session of the first week, she was mostly sleeping. At week 2, she started to follow the movements. At week 3, during the strength training, she showed that she remembered the sequence of the movements by telling the researcher that the movement of the left arm was followed by the right arm. During the exercise, she also told the researcher, "When music stops, we stop," and the researcher said, "Yes," and smiled. On the day of the exercise session, she was able to follow every movement without difficulty. During this exercise session, she was looking out the window while exercising. When the researcher looked at the way she was looking at, she said, "I was looking at the bird." It was a notable change as well by hearing what she said, even though the researcher couldn't tell exactly how much she could see the bird.

Research Question 1: Does a 4-week exercise program influence cognitive abilities of participants with MCI?

Research Objective 1: To compare if the exercise group shows greater improvement on the MMSE scores than the control group at the end of the 4-week exercise program.

At pre-treatment, the mean MMSE score for the exercise group was 25.3 (*SD*= 0.58) and the mean MMSE score for the non-exercise group was 26.3 (*SD*= 1.53). At the end of the 4-week exercise program, the average score in the exercise group was 27.3 (*SD*= 1.16), and the non-exercise was 26.3 (*SD*= 2.52). This result revealed that while the average score in the non-exercise group remained the same after 4 weeks, the average score of the exercise group increased. An independent-sample *t* test (one-tailed) was performed to compare the means of the change in the MMSE of the exercise group with the non-exercise group, and a statistically significant increase in the exercise group compared to the control group was found ($t(4) = 2.45, p<.05$). Therefore, to the research question 1, the answer was yes. A 4-week exercise program did influence cognitive abilities of participants with MCI.

Research Question 2: Does a 4-week exercise program influence behaviors of participants with MCI?

Research Objective 2: To examine if a 4-week exercise program can increase positive behaviors and decrease negative behaviors in the exercise group.

By excluding Exerciser 2, the mean positive behaviors in the exercise group revealed an increase of 41.5 to 42.5. Whereas the mean positive behaviors in the non-exercise group at post-treatment indicated a decrease of 80.7 to 71.0. Negative behaviors observed in Exerciser 1 at pre-treatment were not observed at post-treatment. Therefore,

to the research question 2, the answer was yes. The results indicated that a 4-week exercise program influenced behaviors of participants with MCI in positive ways, increasing positive behaviors and decreasing negative behaviors.

Other Important Findings

All participants in the exercise group were in their 90s, and they were able to improve their cognitive functioning followed by a 4-week exercise program. On the other hand, the participants in the non-exercise group were all in their 80s, and only Non-Exerciser 1 improved by one point. The score of Non-Exerciser 3 remained the same and the score of Non-Exerciser 2 dropped by one point. The results showed that by participating in physical exercise for 4 weeks, older adults in their 90s and initially falling into the MCI category could improve their cognitive functioning.

Another important finding was that the length of stay in a long-term care facility did not relate to improvement in the MMSE scores. When the scores at pre-treatment and at post-treatment were compared, there was no indication that participants who had stayed in the facility longer than others could not improve their scores. In other words, engagement in physical exercise was more important than length of stay in a long-term care facility and age of the participant.

Discussion

In the facility, there were two programs offered to the residents: Restorative Programming (focusing on range of motion, walking, ADLs, independent transfers, toileting, and personal grooming and hygiene) and Morning Stretch (performing voluntary 5- to 10-minute stretching before lunch). Besides the 4-week exercise program for the study, Exerciser 1 and 3 were enrolled in the Restorative Programming, but there

was no one from the non-exercise group involved in these programs. It is unknown whether or not all 6 participants were engaging in Morning Stretch.

The use of music was effective for older adults with cognitive impairment, as previous studies (Lord & Garner, 1993; Winckel et al, 2004) suggested. In fact, participants in the exercise group showed their enjoyment towards the music played by moving their body rhythmically during the exercise, and even after the exercise. Music could have served as extrinsic motivation for them to finish each exercise session.

As previous studies (Molly, Beerschoten, Borrie, Crilly & Cape, 1988; Winckel et al., 2004) showed, an increase in the mean MMSE scores of the exercise group followed by a physical exercise program was also obtained in this study. All participants in the exercise group showed increases in their scores at post-treatment, rising 6 points in total from the pre-treatment. On the other hand, the mean MMSE scores of the control group remained the same, and even one participant showed a one point decrease at post-treatment.

In this study, not only did the MMSE scores of the exercisers increase, but the mean positive behaviors at post-treatment increased. Additionally, a decrease in negative behaviors in the exercise group was observed at post-treatment. These positive outcomes followed by physical exercise were supported in previous research (Brawley, 2004; Poser & Ronthal, 1991).

One explanation as to why Exerciser 3 showed a decrease in positive behaviors at post-treatment could be due to the absence of Exerciser 2 because these two participants were in the exercise group together for 4 weeks, and sat next to each other during the

game. Exerciser 3 was smiling and looking at Exerciser 2 as well as spontaneously talking to her at pre-treatment.

Summary

The exercise group showed their enjoyment towards the music during the exercise, and became physically capable of performing the movements by the 4th week. All participants in the exercise group showed increases in their MMSE scores at post-treatment. The 2-point increase in the mean MMSE score of the exercise group was found to be statistically significant compared to the non-exercise group. This group also showed an increase in mean frequency of positive behaviors and a decrease in mean frequency of negative behaviors. The non-exercise group, on the other hand, revealed no change on the mean MMSE score, and showed a decrease in mean frequency of positive behaviors at post-treatment.

Chapter 5

Conclusions, Limitations, and Recommendations

The whole population is aging, and more people are becoming susceptible to Alzheimer's disease (AD). Although there is no cure for this disease, researchers have identified mild cognitive impairment as a probable sign to develop AD. Treatment for cognitive impairment has also been studied, and music based exercise as well as a combination of aerobic exercise and strength training has found to be effective to improve cognitive tests. While there have been studies showing that physical exercise can produce physical and psychological well-being, the majority of older adults are not engaging in any regular exercise. Therefore, the focus of this study was to measure the influence of a short-term exercise program on cognitive abilities and behaviors of older adults with mild cognitive impairment. The following two objectives based on the research questions were addressed to guide this research:

Research Questions

1. Does a 4-week exercise program influence cognitive abilities of participants with MCI?
2. Does a 4-week exercise program influence behaviors of participants with MCI?

Research Objectives

1. To compare if the exercise group shows greater improvement on the MMSE scores than the control group at the end of the 4-week exercise program.
2. To examine if a 4-week exercise program can increase positive behaviors and decrease negative behaviors in the exercise group.

In the study, the Mini-Mental State Examination (MMSE) was used to measure cognitive abilities of older adults. This test was given to all participants before and after a 4-week exercise program to determine if participants in the exercise group improved their scores. The data indicated that all participants in the exercise group increased their scores at post-treatment whereas the non-exercise group showed no change in the mean MMSE score at post-treatment. Although the mean MMSE score of the exercise group was lower than the non-exercise group at pre-treatment, the mean MMSE score of the exercise group at post-treatment was higher than the non-exercise group at post-treatment. As the results of this study showed, the improvement in test scores after exercise was supported by previous studies (Molloy, Beerschoten, Borrie, Crilly & Cape, 1988; Winckel et al., 2004).

To measure any behavioral changes after 4 weeks, the observer recording sheet was used to count the frequencies of positive and negative behaviors of all participants while attending a game of Bingo. The results showed that the mean positive behaviors of the exercise group increased, and the negative behaviors decreased at post-treatment. As previous research (Brawley, 2004; Poser & Ronthal, 1991) suggested, positive behavioral changes in older adults with cognitive impairment resulted from participating in exercise. However, the use of older adults with the range of 25 to 28 on the MMSE and a music based short-term exercise program could be the first study because the researcher didn't encounter any literature using this method.

The results of this study indicated that music based, chair-seated aerobic exercise with strength training for 4 weeks was influential in improving cognitive abilities measured by the MMSE and resulted in positive behavioral changes.

Limitations

First, the sample size in the study was too small to generalize the results to the whole population. Further study needs to be done with a larger population to confirm the findings. Second, the ratio of male to female (1:5) was small in this study. In further research, an equal number of male and female participants have to be used in both experimental and control groups, so the results can be applied to both genders.

Third, the male participant in the non-exercise group showed a decrease in his test score at post-treatment, but showed an increase in the number of positive behaviors at post-treatment. It could possibly be related to his medication or moods at pre- and post-treatment, though there was no information to explain the changes of his scores. In further studies, at least one psychological test needs to be implemented, and medication of each participant needs to be obtained in order to explain score changes.

Conclusions

The results showed that a short-term exercise program was able to bring positive influences on cognitive abilities and behaviors in older adults with mild cognitive impairment. On the MMSE, every participant in the exercise group scored higher at post-treatment, which increased by two points on average. On the other hand, there was no change in the MMSE in the non-exercise group at post-treatment. This increase in the exercise group was found to be statistically significant compared to the non-exercise group by performing an independent-sample *t* test (one-tailed).

The mean positive behaviors in the exercise group increased and negative behaviors decreased at post-treatment compared to pre-treatment scores. Although the use of specific participants with the range of 25 to 28 on the MMSE was not supported in

previous research, improvement in test scores after participating in physical exercise among cognitive impaired older adults was supported in other studies. The positive behavioral changes in the exercise group followed by physical exercise indicated the similar outcomes of previous studies which focused on Parkinson's disease, depression, and Alzheimer's disease. As the results of this study showed, a combination of chair-seated aerobic exercise and strength training with music for 4 weeks can significantly improve cognitive abilities in older adults with MCI, and increase positive behaviors and decrease negative behaviors as well.

Recommendations

Based on the results of this study, there are some recommendations for the long-term care facilities and communities. First, as the results showed, music based exercise can improve cognitive abilities and reduce negative behaviors. Many facilities and communities need to provide opportunities for exercise and encourage older adults to exercise regularly. Music based physical exercise can be a treatment as well as preventive measures for cognitive decline in older adults. A combination of chair-seated aerobic exercise and strength training for about 20 minutes is desirable to start with for older adults who do not engage in any regular exercise. To be able to effectively conduct an exercise program one must have a solid understanding of older adults in order to lead them in an exercise program to obtain the desired benefits.

Educating middle-aged adults about the importance of regular exercise before they are over 60 may help them to exercise regularly later on. Informing the baby-boomers about the benefits of regular physical exercise is essential. The media, health service providers, and exercise facilities can aid in educating this population regarding

the benefits of exercising. To start something new is always challenging. Therefore, free trials need to be provided as incentives for middle-aged adults to start exercising regularly and choose the best environment to continue such an important behavior with clear physical and psychological benefits.

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Appendix A

Mini-Mental State Examination

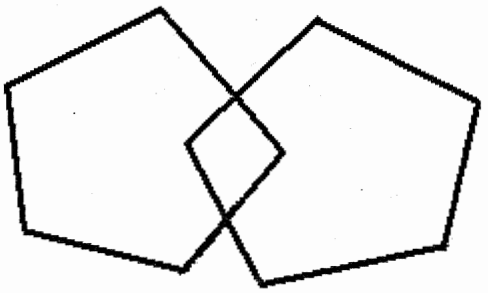
Participant's Name:_____ Date:_____

	Score
Orientation What is the (year), (season), (month), (date), (day)? 5pts.	_____
Where are we: (state), (county), (city), (facility), (floor)? 5pts.	_____
Registration Name three objects: 1 second to say each, (sky, table, red). Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until s/he learns all 3. Count trials and record. Record the 1st trial but let the patient learn up to 6 trials.	_____
Attention and Calculation Ask to spell "world" backwards d___ l___r__o___w___. 1 point each . 5pts.	_____
Recall Ask for the 3 objects repeated above. Give 1 point each. 3pts.	_____
Language Name a pencil, and watch. 2pts.	_____
Repeat the following "No ifs, ands, or buts." 1pt.	_____
Follow a three stage command: "Take a paper in your right hand, fold it in half, and put it on the floor." 3pts.	_____
(Refer to next page) Read and obey the following: "CLOSE YOUR EYES." 1pt.	_____
Ask to write a spontaneous sentence. 1pt.	_____
Copy the intersected pentagons. 1pt.	_____
Total score	_____

CLOSE YOUR EYES

Write a spontaneous sentence:

Copy the intersected pentagons below:



Appendix B

Observer Recording Sheet

Participant's Name: _____ Number of Exercise Session(s) Completed:_____

Behaviors										Total
1 Responds to peer, instructor, staff										
2 Talks spontaneously to peer, instructor, staff										
3 Offers help to peer, instructor, staff										
4 Participates in activity										
5 Looks at peer, instructor, staff										
6 Smiles										
7 Appropriately touches peer, instructor, staff										
8 Laughs										
9 Withdraws from activity										
10 Displays agitation										
11 Displays anxiety										
12 Displays aggression/other inappropriate behaviors										

Appendix C

Consent Form

A Study of an Exercise Program and Older Adults

April 27, 2005

Dear Caregiver or Family Member (or POA) of an Older Adult,

I'm a graduate student of Eastern Illinois University and seeking male and female participants aged 60 or older with mild cognitive impairment to participate in a master's level thesis research project on the benefits of a 4-week exercise program on cognitive abilities and behaviors. Older adults will be randomly assigned to either an exercise group or a non-exercise group. If they are in the exercise group, they will participate in a mild exercise session 3 times per week after obtaining doctor's permission to exercise. The type of exercise is a combination of chair-seated aerobic exercise (15 minutes) and strength training (5 minutes). A water bottle (0.5L) will be used as a weight for strength training. Movements in the exercise mainly involve their arms, head, fingers, wrists, and legs. During these exercises, music will be played. They may or may not have sore muscles or tiredness, and they are likely to gain strength if they participate in all sessions.

A ____ staff member will give the older adults the Mini-Mental State Examination, which takes about 5-10 minutes, before and after the 4-week program. I will also videotape their participation in Bingo for 20 minutes, before and after the exercise program. These activities described above will be carried out at _____. The video recording will be used for behavior analysis only and will not be shown to anyone.

Participation in this study is voluntary, and you and your family member can withdraw from the study anytime. Information collected for this study from each

individual will be confidential. Your participation will contribute to further understanding of exercise benefits to older adults. If you have any questions regarding this study, please contact Kaori Mitsui at (___) ___-____ or Dr. Jeanne Snyder at (___) ___-____. Please be sure to check the appropriate box, sign below, and return this form to Administrator Mrs. _____, or social service personnel, _____ _____ by May___, 2005. Thank you very much for your cooperation.

[ ] I give my permission for my family member to participate in the study, and I will also give my permission for _____ staff members to provide information regarding age, gender, and length of stay at _____.

[ ] I do not give my permission for my care receiver to participate in the study, and I will not give my permission for _____ staff members to provide any information regarding my family member for the study.

_____ _____

Care Receiver's Name Family Member or Caregiver's Signature Date

Appendix D

Movements in Aerobic Exercise

Arms up & down

Arms to right & left

Shoulder up & down

Arms forward, close & open fingers

Make steps (count 10)

Heels up & down

Toes up & down

Turn thumbs forward

Turn thumbs backward

Twist waist side to side

Right arm up, close & open the fingers

Left arm up, close & open the fingers

Right shoulder up & down, left shoulder up & down

Move head to right, front, left, front

Swim forward

Swim backward

Arms forward, move fists in circle

Right hip up & down, left hip up & down

Stomach in & out

Arms up in the air, move to right and left

Make circles with arms

Make circles with arms the other way around

Arms forward, move fists up & down

Move knees to right & left

Move arms and legs like walking

Moves arms only and faster

Make steps and faster

Move arms and legs together and faster

Make circle with shoulders forward

Make circle with shoulders backward

Hold hands and make waves

Face right palm and left palm, and move them to right & left

Move upper arms to backward

Bring arms down, and move fingers

Appendix E

Movements for Strength Training

Right arm up & down to shoulder

Left arm up & down to shoulder

Turn right wrist

Turn left wrist

Right arm back & front

Left arm back & front

Right arm down & up to chest height

Left arm down & up to chest height

Right arm forward, and bend and stretch

Left arm forward, and bend and stretch

Move right arm to the left & right

Move left arm to right & left

Right arm forward, and hold for ten seconds

Left arm forward, and hold for ten seconds

Appendix F

Participants at a Game of Bingo