Group-based exercise for people with mild cognitive impairment: a pilot study

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ABSTRACT

Tortosa-Martínez J, Caus-Pertegaz N, Martínez-Canales C. Group-based exercise for people with mild cognitive impairment: a pilot study. *J. Hum. Sport Exerc.* Vol. 8, No.Proc3, pp. S702-S710, 2013.The number of neurodegenerative diseases associated to aging, such as Alzheimer´s disease (AD), is rapidly increasing. Mild cognitive impairment (MCI) is diagnosed when a person presents cognitive deficits, usually memory related, but still does not meet criteria for a diagnosis of dementia. It is usually considered a transitional phase between normal aging and dementia. The benefits of exercise for people with mild cognitive impairment are not fully clear and deserve further research. The aim of this pilot study was to analyse the physical benefits of a group-based exercise program for people with mild cognitive impairment. Using a pre-post design, twenty people with MCI were recruited and divided into an experimental group (10), who followed a three-month exercise program, and a control group (10) who followed routine care. The results of this study show that engaging in a supervised exercise program was effective for improving performance in the Six Minute Walk Test (6MWT), the Timed Get Up and Go Test (TGUP), and the 8-meter walk test, implying gains in cardiovascular capacity, gait and dynamic balance. After the intervention period, the control group not only did not improve in any of the fitness tests, but also showed significant worse performance in the (6MWT) and the Tinetti total score. Thus, a supervised group-based exercise program can represent a feasible and effective strategy for improving physical function in people with MCI. **Key words**: MILD COGNITIVE IMPAIRMENT, PHYSICAL ACTIVITY, ALZHEIMER´S DISEASE, GAIT, BALANCE.

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INTRODUCTION

The population of persons with 65 years or older is increasing exponentially due to a higher life expectancy in industrialized countries. As a consequence, the incidence of neurodegenerative diseases in older people such as Alzheimer´s disease (AD) is rapidly increasing, creating serious concern for families, caregivers, professionals and others in public health systems (Haan & Wallace, 2004). Brookmeyer et al., (2007) estimated that in 2006 there were 26 million cases of AD worldwide. They also estimated that in 2050, this number will increase up to a 100 million cases. AD is the most common sub-type of dementia, and it is characterized by a progressive deterioration of higher cognitive functioning in the areas of memory, problem solving, and thinking. Another characteristic is the inability to carry-out everyday tasks or perform instrumental activities (Rimmer & Smith, 2009).

Considering the projected number of cases and the social and economic impact of AD it is imperative to design feasible strategies to prevent, delay or treat this disease. This has important implications for healthy populations but even more relevant for those who are at more risk of suffering from it. Mild Cognitive Impairment is considered a clinical condition in which the person experiences memory loss to a greater extent to what it would normally be expected from normal aging, but still does not meet criteria for a diagnosis of dementia (Petersen et al., 1999). There are two types of MCI, amnestic and non-amnestic. A diagnosis of amnestic Mild Cognitive Impairment includes memory loss, and it is usually considered a transitional phase between normal aging and Alzheimer´s disease (Petersen et al., 2004).

There is a growing body of evidence showing that regular physical activity has protective effects against MCI, dementia, and AD (Laurin et al., 2001; Abbott et al., 2004; Podewils et al., 2004; Rovio et al., 2005; Karp et al., 2006; Larson et al., 2006; Simons et al., 2006; Taaffe et al., 2008; Geda et al., 2010). There is also increasing evidence of the positive effects of physical activity for people who already have Alzheimer´s disease and other dementias (Tappen et al., 2000; Arkin, 2003; Williams & Tappen, 2007; Christofoletti et al., 2008; Lautenschlager et al., 2008; Amand & Thomas, 2009; Kemoun et al., 2010; Yagüez et al., 2011). However, the benefits of physical activity for people with Mild Cognitive Impairment are less clear, with only a limited number of scientific studies available in the literature (for a recent meta-analysis, see Gates et al., 2013). There is a need for more research in this field to gain a better understanding of the benefits of exercise for people with MCI, and also to advance in the correct prescription of exercise for this population.

Therefore, the aim of this study was to examine the feasibility and physical benefits of a group-based exercise program for people with MCI. We hypothesized that supervised aerobic group exercise would be a feasible strategy for improving physical fitness in this population.

MATERIAL AND METHODS

Participants

Twenty people diagnosed with Mild Cognitive Impairment, according to Petersen et al. (2004) criteria, were recruited from the Neurology Unit of the Hospital de San Vicente by trained neurologists using an intentional non-probabilistic sampling method. The sample was divided into two groups: the experimental group (10) who followed an exercise program, and the control group (10) who continued with routine care. Those who were able and willing to attend to the program were included in the experimental group and the rest were allocated in the control group. General exclusion criteria included non-compliance with testing procedures; physical, cardiovascular or sensorial limitations for doing exercise safely; severe apathy, delirium or agitation.

Measures

The six minutes walk test (6MWT)

The six minutes walk test (Enright & Sherrill, 1998) is a submaximal test measuring one´s level of aerobic fitness. The test is known to well reflect the functional exercise level during daily physical activities and it is a suitable test for elderly people (Enright et al., 2003). The test has also been used in populations with dementia (Tappen et al., 2000; Arkin, 2003; Williams &Tappen, 2007).

Participants were requested to walk as far as possible for 6 minutes, without running or jogging, through a circuit of a rectangular shape marked with cones separated five meters each one for a total of 50 meters each complete lap. Participants were allowed to stop if they needed to during the test. A research assistant timed the walk and recorded the distance travelled by participants to the nearest cone.

Timed Get Up & Go Test

This test is aimed to assess agility and dynamic balance and has been used previously in people with mild cognitive impairment (Shumway-Cook et al., 2000). The test requires a subject to stand up from a chair, walk 2.44 meters to a cone, turn, walk back, and sit down. Time taken to complete the test is strongly correlated to level of functional mobility. The participant was requested to: "Sit with your back against the chair. At the command `go,' stand upright, then walk as fast as possible to the cone in front of you, turn around, return to the chair, and sit down. The stopwatch was started on the word `go' and stopped when the subject returned to the starting position.

Eight meters walk test

The 8-meter test is a self-paced walking test (Bennell et al., 2011), which measures functional mobility and gait. The individual walks as fast as possible without assistance 10 meters following a visual reference, and the time is measured for the intermediate 8 meters to avoid that the participant stops too early in the test.

Tinetti balance and gait test

The Tinetti test (Tinetti et al., 1986) has been widely used in the elderly to assess balance and gait, and predict falls (Köpke & Meyer, 2006). It has also been used in people with Mild Cognitive Impairment (Bermejo et al., 2008). The version published by Rubenstein (1992) was applied in this study. This version assesses balance with 9 items (score out of 16) and gait with 7 items (score out of 12) for a total score out of 28, where the higher the score, the better the performance and lower the risk of falls.

Procedures

The study followed the principles outlined in the Declaration of Helsinki of 1975. The protocol was approved by an ethics committee, both in the University of Alicante and the Hospital de San Vicente. All participants gave written informed consent to the protocol and were advised that the refusal of participation in the study would not affect future treatment.

Intervention and testing

The exercise program was conducted for three months, three sessions per week, lasting for one hour each session. Aerobic exercises were the main component of the program. Some strength, balance and flexibility exercises were also included. Aerobic exercises were performed at approximately 60 to 75% of the maximum heart rate. The intensity started at as low as 40% and was progressively built up to the target training zone. All participants were monitored with Polar Heart Rate monitors in order to control the intensity of the exercises and the adaptation to the exercise, as well as to assure that the training goals were achieved. All sessions included a warm up, main phase, and a cool down. The program was conducted in group, promoting social interaction.

All fitness tests were performed before and after the exercise program by both the experimental group and the control group, in the sports facilities of the University of Alicante.

Statistical Analysis

Statistical analysis was performed using the SPSS statistical package version (SPSS 19.0. for Windows). Descriptive baseline characteristics were tabulated as mean (±SD) for continuous variables or as percentages for categorical ones (Table 1). Data distribution was checked by the Shapiro-Wilk test and homocedasticity was checked by the Levene test. Bivariate relations among the fitness test variables and age, gender, blood pressure and educational level at baseline were assessed by the Pearson correlation coefficient for continuous variables and the Spearman correlation coefficient for non-normally distributed data. Group differences analysis between the experimental group and the control group at baseline was conducted using unpaired t test for normally distributed variables and the Mann-Whitney U-test for non-normally distributed variables. The effects of the exercise program on the different fitness tests were assessed using a t test for paired samples. All reported P values are two-sided and the significance level was set at 0.05.

RESULTS

Main characteristics of the sample

The final sample was comprised of 20 people with MCI (10 men and 10 women), with a mean age of 76 years-old. Table 1 shows the main characteristics of the sample considering group differences. There were no significant differences between the experimental group and the control group in regards to age, gender, blood pressure or any of the fitness tests.

Table 1. *Baseline characteristics of the study population*

	Sample	**Experimental group**	**Controlgroup**
N	*20*	*10*	*10*
Age *(years)*	*76,25±7,6*	*74,10±8,4*	*78,40±6,3*
Gender			
Women	50%	40%	60%
Men	50%	60%	40%
Systolic Blood Pressure	133±*12*	131±*12*	135±*12*
Dyastolic Blood Pressure	74±*9*	75±*10*	73±*9*

Correlations at baseline

Considering both groups at baseline, before the exercise program, age was positively correlated with the 8-meter walk test [0.462; p=0.04], and negatively correlated with the 6MWT [-0.549; p=0.012], the Tinetti balance [-0.555; p= 0.011], and the Tinetti total score [-0.548; p=0.012]. Gender presented no correlations at all with any of the fitness tests. The results of the different fitness tests were highly correlated to each other, except for the Tinetti balance test that was only correlated to the Timed Get Up and Go test [-0.570; p= 0.009] and the Tinetti total score [0.694; p= 0.001].

Effects of the exercise program in fitness levels
After the exercise program, the experimental group improved the performance in the 6MWT [t=-3,497; p=0,008], the TGUG test [t=4,747; p=0,001], and the 8-meter walk test [t= 2,654; p=0,029]. In contrast, the control group did not improve in any of the fitness tests and showed a worse performance in the 6MWT [t=2,942; p=0,016] and the Tinetti total score [t=3,354; p=0,008].

Table 2. *Pre-post test values for the fitness tests*

	PreExp.	Post Exp.	PreControl	Post Control
Six Minute Walk Test (6MWT)	*425,00 (±46,2)*	*468,88 (±45,0)***	*374,50 (±122,5)*	*340,00 (±123,3)**
8 meter walk test	*8,50 (±2,3)*	*5,95 (±0,9)**	*8,24 (±3,7)*	*8,00 (±3,2)*
Timed Get Up & Go test (TGUG)	*9,66 (±1,7)*	*7,10 (±1,6)****	*10,21 (±5,9)*	*11,00 (±4,5)*
Tinetti Balance	*15,22 (±1,3)*	*14,22 (1,5)*	*13,90 (±1,7)*	*12,70 (±2,0)*
Tinetti Gait	*10,33 (±1,5)*	*10,77 (±1,4)*	*11,10 (±2,2)*	*11,30 (±2,7)*
Tinetti total score	*25,55 (±2,4)*	*25,00 (±2,6)*	*25,00 (±2,9)*	*24,00 (±2,8)***

DISCUSSION

Physical activity, when performed regularly, has several benefits for the physical health of older adults such as cardiovascular, gait, or balance benefits (Taylor et al., 2004). There is also increasing evidence about the protective effect of physical activity against developing MCI, AD, or any other type of dementia (Laurin et al., 2001; Abbott et al., 2004; Podewils et al., 2005; Rovio et al., 2005; Karp et al., 2006; Larson et al., 2006; Simons et al., 2006; Taaffe et al., 2008; Geda et al., 2010). A few studies have focused on the physical benefits of exercise for people with MCI (Baker et al., 2010; Uemura et al., 2012). A recent meta-analysis conducted by Gates et al. (2013) showed that cognitive benefits resulting from exercise programs for people with MCI are modest so far.

The present study focused on a group-based exercise intervention to assess the physical benefits and the feasibility of this type of programs for people with MCI. Our results confirm that exercising in group can be feasible and produces physical benefits for this population. Participants in the experimental group improved their performance in several fitness tests such as the 6MWT, the TGUG, and the 8-meter walk test, while their performance in the Tinetti tests remained unchanged. The control group did not improve in any of the fitness tests, but it did show a significant decrease in the performance of the 6MWT and the Tinetti total score.

At baseline, the mean distance covered in the 6MWT was 425 and 374 for the experimental group and the control group respectively, when expected distances for a group of healthy people of similar age would be over 600 meters (Trooster et al., 1999). Thus, people with Mild Cognitive Impairment have a poorer cardiovascular capacity than healthy people of their same age.

The increase in the mean distance covered in the 6MWT by the experimental group after completing the exercise intervention was 43 meters. The fact that the control group not only did not increase the distance covered during the test, but also decreased the average distance covered by 34 meters, make the positive results of the intervention group even more relevant. These improvements shown in the 6MWT by the intervention group imply cardiovascular and general physical function benefits (Enright & Sherrill, 1998).

The TGUG test has been correlated with the risk of falls (Shumway-Cook et al., 2000) and more recently with executive function (McGough et al., 2011). A worse performance on this test represents, thus, a higher risk of falling (Shumway-Cook et al., 2000) and it is also correlated with poorer executive function (McGough et al., 2011). Declining physical function combined with decreased cognitive function has been associated with increased risk of dementia and also disability (Scherder et al., 2007). Thus, the significant improvement in the performance of this test shown by the experimental group in our study may represent an opportunity for delaying the onset of dementia and disability.

The 8-meter walk test measures the speed of gait, which is correlated with physical function as well as cognitive function (Scherder et al., 2007). The speed of gait decreases as an adaptation to aging, in order to reduce the risk of falling (Menz et al., 2003). In people with MCI, this slower gait is more pronounced (Scherder et al., 2007). Furthermore, if the person develops a dementia, it usually has as a consequence a higher deterioration of gait, and as the severity of the dementia progresses gait will also continue to deteriorate (Sheridan & Hausdorff, 2007). In our sample, the experimental group improved significantly the performance in the 8-meter walk test after the exercise program, which represents an improvement in their physical functionality. An older adult´s ability to increase walking speed above a “comfortable” pace may correlate with a potential to adapt to varying environments and task demands (eg, crossing streets; avoiding obstacles) (Steffen et al., 2002). However, we did not measure activities of daily living so we can´t be sure about the impact of this improvement in the participants´ daily lives.

Balance and gait are highly correlated to risk of falling (Köpke & Meyer, 2006). Falling is considered a serious public health concern among elderly people due to its frequency, the morbidity often associated, and the cost of the necessary health care after falling (Tinetti et al., 1994). In our study, the Tinetti test was used to assess static balance and gait, having a separate score for each variable and a composite score for both of them. Using the version published by Rubenstein (1992), a total score of less than 18 would correlate with high risk of falling, a total score of between 18 and 23 would represent a moderate risk of falling, while a total score higher than 24 would be considered a low risk of falling. Both groups (experimental and control) had a total score of around 25 at baseline, which represents a low risk of falling. The experimental group did not show any significant changes after the exercise program while the control group did decrease this score down to 24, getting close to the category of moderate risk of falling. However, even though this decrease was statistically significant, the clinical relevance of a 1-point decrease in the Tinetti total score needs to be interpreted with caution.

Some limitations of the study should also be recognized. First, an important limitation was the sample size, which was rather small, and does not allow for generalization of the results. Another limitation is the lack of randomization between the experimental group and the control group. In regards to gait measurements, some frequent gait adaptations such as step and stride length and frequency were not measured in this study and should be considered in future research. The correlation of the fitness tests with cognitive tests after the intervention could be also of interest. Finally, a healthy control group to compare results would have been appropriate.

CONCLUSIONS

A group-based exercise program focused mainly on different aerobic exercises represents a feasible strategy for improving physical fitness in people with Mild Cognitive Impairment. After the intervention, those who participated in the exercise program presented gains in the 6MWT, the TGUG, and the 8-meter walk test while the performance of the control group in these tests remained unchanged. This implies cardiovascular benefits, improved gait speed and enhanced dynamic balance. The quality of gait and the static balance showed no significant change in the experimental group, while decreased in the control group. The fact that there were no drop outs during the intervention is also a good marker of the feasibility of the program. Further research, including a larger sample, randomization, and a healthy control group, is needed to confirm the findings of this study.

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