Article

CLINICAL REHABILITATION

Clinical Rehabilitation
2019, Vol. 33(3) 439–449

DOI: 10.1177/0269215518815218
journals.sagepub.com/home/cre
SAGE

The effect of group exercises on balance, mobility, and depressive symptoms in older adults with mild cognitive impairment: a randomized controlled trial

Chandra da Silveira Langoni[1], Thais de Lima Resende[2], Andressa Bombardi Barcellos[2], Betina Cecchele[2], Juliana Nunes da Rosa[2], Mateus Soares Knob[2], Tatiane do Nascimento Silva[2], Tamiris de Souza Diogo[2], Irenio Gomes da Silva[1] and Carla Helena Augustin Schwanke[1]

Abstract

Objective: To determine the effects of group exercises on balance, mobility, and depressive symptoms in community-dwelling older adults with mild cognitive impairment.

Design: Single blinded, randomized, matched pairs clinical trial.

Setting: Four primary healthcare units.

Subjects: Fifty-two sedentary subjects with mild cognitive impairment were paired (age, sex, body mass index, and Addenbrooke's Cognitive Examination Revised score), tested, and then randomized into an intervention group ($n = 26$) and a control group ($n = 26$).

Intervention: The intervention group performed strength (ankle weights, elastic bands, and dumbbells) and aerobic exercises (walking) in their communities' public spaces, twice a week (60 minutes each), during 24 weeks. The control group maintained its usual routine.

Main measures: Balance (Berg Balance Scale (BBS)), mobility (Timed Up and Go Test (TUG)), and depressive symptoms (Geriatric Depression Scale-15) were assessed before and after the intervention.

Results: Before the intervention, the two groups did not differ statistically. After, the intervention group showed significant improvement ($P < 0.05$) in balance (before: 53 ± 3; after: 55.1 ± 1.1 points), mobility

[1]Institute of Geriatrics and Gerontology, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Brazil
[2]School of Health Sciences, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Brazil

Corresponding author:
Professor Thais de Lima Resende, School of Health Sciences, Pontifical Catholic University of Rio Grande do Sul, Av. Ipiranga, 6690 – Prédio 81 – 6° andar – sala 603, Porto Alegre, Rio Grande do Sul, CEP: 90619-900, Brazil.
Email: thaislr@pucrs.br

(before: 10.7 ± 2.9 seconds; after: 8.3 ± 2 seconds), and depressive symptoms (median punctuation (interquartile range) before: 4 (1.8–6); after: 2.5 (1–4)). The control group presented a significant increase in their depressive symptoms (median before: 3.5 (2–7.3); after: 4 (2–5.3)), while their balance and mobility showed no significant modification. Small effect sizes were observed in the intervention group and control group depressive symptoms, as well as in the control group's mobility and balance. Large effect sizes were observed the intervention group's mobility and balance.

Conclusion: Group exercises improved balance, mobility, and depressive symptoms in community-dwelling older adults with mild cognitive impairment.

Keywords

Aging, depression, physical conditioning, muscle strength, public health

Received: 2 March 2018; accepted: 2 November 2018

Introduction

Functional dexterity, cognitive function,[1] and social engagement[2] tend to decline with aging. Older adults with mild cognitive impairment are even more susceptible to worsening of these conditions and their negative consequences due to the high chance of developing dementia.[3]

However, despite the changes that accompany aging, individuals who exercise feature advantages in comparison with sedentary ones, such as mood improvement, enhanced cognitive functioning, brain plasticity, increased neurotransmitters' production, among others.[4] Among the possible modalities, group exercises can keep older adults functionally active and enable them greater social contact, and maintain their autonomy and independence. For this age group, participating in an exercise program closer to home can be more practical and, therefore, result in increased adherence to and acceptance of the program.[5] In addition, it can reduce public health costs.[6]

Furthermore, although older adults with mild cognitive impairment do not exhibit functional decline that might compromise their independence,[3] they have a higher chance of exhibiting reduced mobility[7] and balance[8] than older adults without. In addition, they are more likely to develop depression, which may exacerbate pre-existing cognitive difficulties, and hamper adherence to treatments. Moreover, both comorbidities are accentuated by aging.[9]

Consequently, it is necessary to promote interventions that impact positively on those aspects.[10] Notwithstanding, the majority of the published studies were carried out at universities, using equipment and spaces which will often be unavailable to or unfeasible to use with the general population.[11] Thus, it is necessary to establish ways to bring these benefits closer to those who need it. This is particularly relevant to the local population—impoverished and socially vulnerable.[12] Therefore, the aim of this study was to assess the effects of an aerobic and strength group exercise program developed for the primary care on balance, mobility, and depressive symptoms in older community-dwelling adults with mild cognitive impairment.

Methods

This study is part of a larger project titled "Effects of an aerobic, strength and cognitive training program on the mild cognitive decline of Primary Health Care elderly users in Porto Alegre," approved by the Pontifical Catholic University of Rio Grande do Sul Ethics Committee (no. 427.997/2013), registered by the Brazilian Clinical Trials Registry (no. RBR-6y2srf), and conforms to the Declaration of Helsinki. All participants signed a written informed consent form prior to enrolment.

Part of the above-mentioned project was published recently,[13] including the methods, which are partially shared with this study, besides the participants. Notwithstanding, all the outcomes presented here are exclusive to this study.

This single-blinded, randomized, matched pairs, controlled clinical trial was conducted from October 2015 to March 2017 in five phases: (1) recruitment, (2) first battery of tests, (3) randomization, (4) 24 weeks of intervention, and (5) last battery of tests (Figures 1 and 2).

Participants

The participants were recruited from four primary healthcare units. The units' older users underwent three selection processes:[13] (1) verification of compliance with the selection criteria in each medical record, (2) home visits to confirm whether they met the selection criteria, and (3) application of the Addenbrooke's Cognitive Examination Revised[14] score to determine the presence of mild cognitive impairment.

The sample was composed of sedentary individuals, aged 60 years or older, able to walk independently to the site of testing and training. Katz index[15] (score $\geqslant 5$) and Pfeffer et al.'s[16] functional assessment (score $\leqslant 2$) were used to confirm that the participants did not have dementia.[17]

The exclusion criteria were as follows: history of severe psychiatric or neurological disorders; current abuse of chemical substances; use of acetylcholinesterase inhibitors; significant communication deficiencies; simultaneous participation in other studies; regular physical activity at least once a week; physical therapy treatment in the three months prior to this study; physical and functional limitations that prevented the practice of exercises; suffering from diseases that cause disabilities; severe visual deficits; recurrent vertigo; and uncontrolled systemic arterial hypertension.

Outcome measures

Before each data collection, researchers were trained on the application of tests and instruments. The participants were assessed immediately before and immediately after the 24-week intervention/control period, in their respective community centers. We collected sociodemographic and anthropometrical data, measured balance, mobility, and depressive symptoms.

Balance was measured using the Brazilian version of the Berg Balance Scale[18] and mobility using the Timed Up and Go Test.[19] We applied the 15-item Geriatric Depression Scale,[20] which detects depressive symptoms in older adults. A score of 5 or more points diagnoses depression.[20] The Berg Balance Scale score was defined as the primary outcome; individuals scoring less than 45 points may be at greater risk of falling.[18]

After the first tests, the participants were matched by sex, age, body mass index, and the Addenbrooke's Cognitive Examination Revised score. One of the researchers not involved with the recruiting, testing, or training of participants received a spreadsheet with the participants' code number and their data pertaining to the matching process. Participants were matched and then were randomly allocated in a 1:1 ratio to one of the two groups, intervention or control. The allocation was defined by a computer-based (Microsoft Excel) random number sequence: a final odd number would mean intervention group and a pair number control.

Intervention

Community centers, parks, and streets near the participants' residences were used for the activities. The intervention group participated in twice weekly sessions of group exercises (60 minutes each), with volume and intensity regularly adjusted.[13] Before and after the exercises, the participants had their blood pressure and radial pulse measured and performed stretching exercises. Once a week, the participants wore a heart rate monitor to ensure aerobic conditioning by working within the range between 60% and 75% of their maximal heart rate, individually determined by the formula "$HRmax = 220 - age$."[21] The materials used for strength training were ankle weights, elastic bands, dumbbells, and balls. For aerobic training, the participants walked for 20 minutes at their target training heart rate during the first month. This time was gradually increased to 30 minutes by the 11th week and maintained until the end of the 24th week.[13]

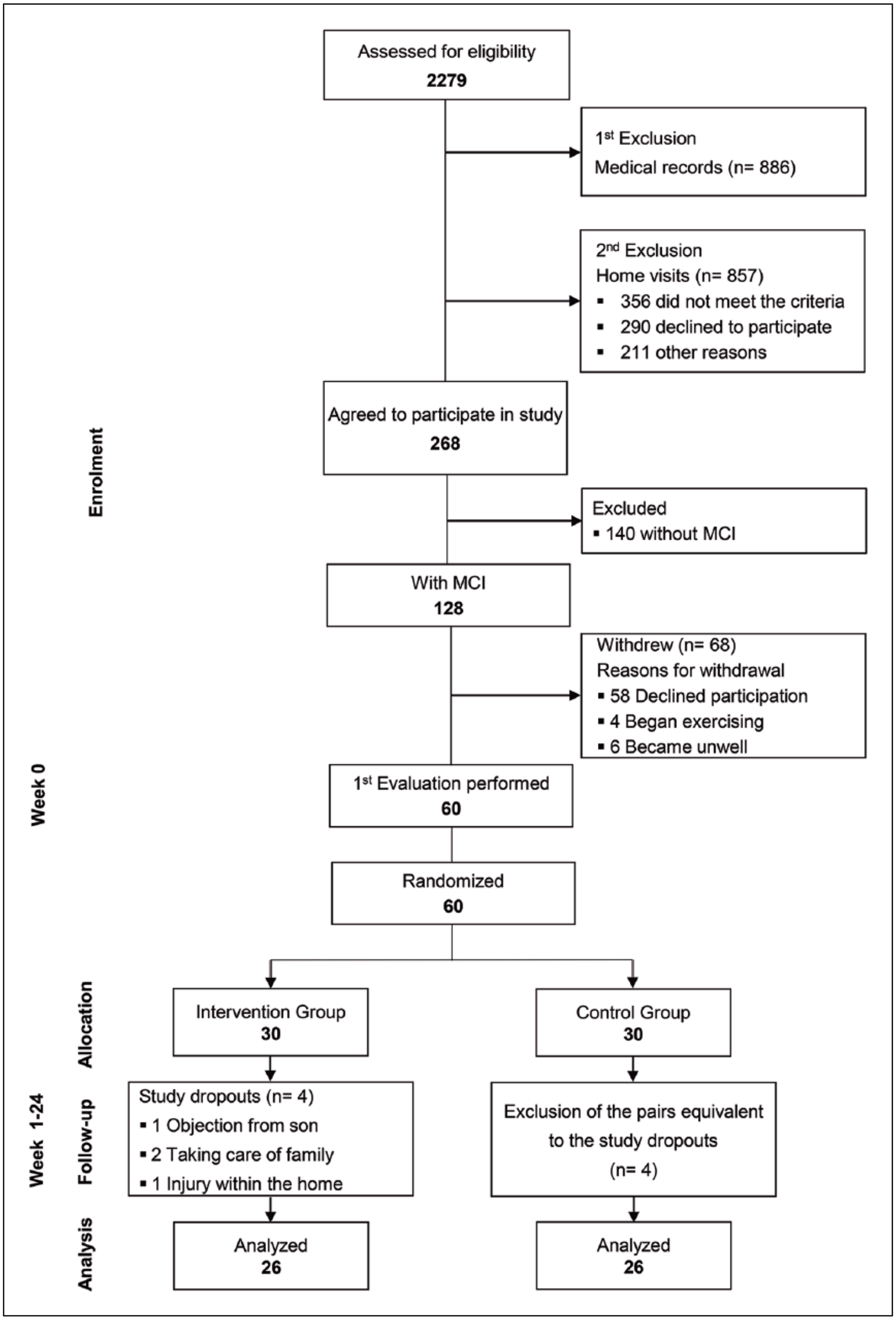

Figure 1. Flow diagram of subjects in the study (used with permission).[13]
MCI, mild cognitive impairment.

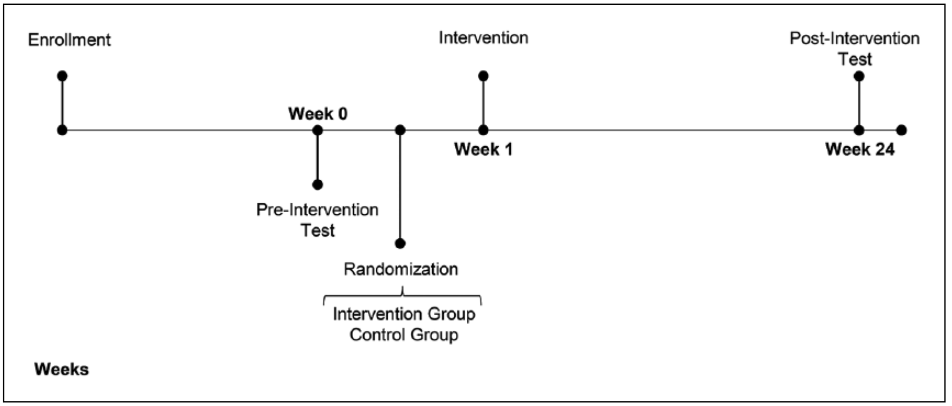

Figure 2. Intervention timeline.

At the beginning of the study, we phoned all the intervention group participants to remind them of the training sessions. If one of the participants missed a session, an extra one was offered to him or her as soon as possible.

The participants of the control group were asked to keep their usual life routine. Once a month, they were contacted by telephone with the purpose of detecting involvement in any kind of activity that was not part of their routine.

Data analysis

Based on the after-intervention Berg Balance Scale data presented for both groups in Table 2, considering a power of 80% and α of 5%, it was determined that 20 participants would be necessary in each group.

Variables were coded and the data were sent to a statistician with no connection to the research group, who run the statistical analysis blinded to both variables' identification and the study details.

A significance level of 5% was adopted. The Shapiro–Wilk test was used to assess the distribution of continuous data and the following tests were used: Pearson's chi-square test with continuity correction, Fisher's exact test (Monte Carlo simulation), Student's *t*-test, and Mann–Whitney's *U*-test. Two-way repeated-measures analysis of variance (ANOVA) was used to investigate the time-by-group interactions, with study of the sphericity assumptions (Box's M and Mauchly's tests). When the assumption of sphericity was not met, correction occurred by the Greenhouse–Geisser Epsilon. Bonferroni correction was applied to adjust for multiple comparisons of the means for the main effects. The calculation of the effect size of continuous variables was performed using Cohen's *d*, and the categorical variables were assessed using Cramer's *V* statistics.

Results

In the course of the study, out of the 60 recruited subjects, four intervention group participants were excluded. One of them had fallen when making repairs to a roof, two women withdrew to take care of family members, and another one was not allowed by her son to continue the exercises. Consequently, their control group pairs were also excluded. Hence, the final sample was composed of 52 participants (Figure 1).

The sociodemographic and anthropometric characteristics of the sample are presented in Table 1, which show that the two groups did not differ statistically in any of the variables analyzed. There was a predominance of overweight, low-educated, White women over 70 years, who did not live with a partner and had worked outside their homes.

Before the study, the two groups did not differ in terms of the functional characteristics assessed, the median Geriatric Depression Scale score, and the

Table 1. Sociodemographic and anthropometric characteristics of the two groups of the sample at the beginning of the study (used with permission).[13]

Variables	Group		*P*-value
	Intervention (*n* = 26)	Control (*n* = 26)	
Sex[a]			
Female	20 (76.9)	20 (76.9)	>0.999[b]
Male	6 (23.1)	6 (23.1)	
Marital status[a]			
Lives with a partner	11 (42.3)	8 (30.8)	0.565[b]
Does not live with a partner	15 (57.7)	18 (69.2)	
Education[a]			
Illiterate	6 (23.1)	8 (30.8)	0.798[c]
Low educational level	13 (50)	11 (42.3)	
Mean educational level	7 (26.9)	7 (26.9)	
Self-declared ethnicity[a]			
White	16 (61.5)	13 (50)	0.775[d]
Black	6 (23.1)	10 (38.5)	
Mestizo	3 (11.5)	2 (7.7)	
Indigenous	1 (3.8)	1 (3.8)	
Other			
Religion[a]			
Catholic	15 (57.7)	20 (76.9)	0.223[d]
Evangelical	8 (30.8)	3 (11.5)	
Spiritist/Umbandist	2 (7.7)	3 (11.5)	
Other	1 (3.8)		
Profession[a]			
Works/worked outside the home	19 (73.1)	19 (73.1)	>0.999[b]
Did not work	7 (26.9)	7 (26.9)	
Age (years)			
Mean ± SD (range)	72.6 ± 7.8 (60.7–88.3)	71.9 ± 7.9 (60–88)	0.740[e]
Body mass index (kg/m^{-2})			
Mean ± SD (range)	27.8 ± 4.4 (17–37.1)	26.3 ± 5.1 (15.7–37.5)	0.268[f]

[a]Percentages obtained based on the total of each group and presented in *n* (%); low educational level: up to 8 years of schooling; mean educational level: 9 to 11 years of schooling.
[b]Pearson's chi-square test with continuity correction.
[c]Pearson's chi-square test.
[d]Fisher's exact test.
[e]Student's *t*-test for independent groups assuming variance homogeneity.
[f]Student's *t*-test for independent groups assuming variance heterogeneity.

presence of depressive symptoms (Table 2). At the end, we observed a significant difference between the groups in the final Berg Balance Scale scores (Table 2), indicating that the mean in the intervention group was greater than that of the control group. There was a significant intra-group difference only in the intervention group, which presented a mean increase of 3.9%. We observed a time-by-group interaction ($F(1,50) = 12.89$; $P = 0.001$; power = 94.1%), which indicated a differentiated variation between the initial and the final means of the Berg Balance Scale scores in the

Table 2. Comparison of depressive symptoms and functional characteristics in the two groups of the sample, before and after intervention.

Variables	Group		Between-group difference, (95% CI)	*P*-value
	Intervention ($n=26$)	Control ($n=26$)		
BBS, before (points)				
Mean ± SD (range)	53 ± 3 (45–56)	54.1 ± 2.3 (48–56)	−1.1 ± 0.7 (−2.5 to 0.4)	0.148[a]
BBS, after (points)				
Mean ± SD (range)	55.1 ± 1.1 (52–56)	53.3 ± 3 (46–56)	1.8 ± 0.6 (0.5 to 3.0)	0.008[a]
Within-group difference				
Mean ± SD	−2.1 ± 2.5	0.8 ± 3.2		
95% CI	(−3.1 to −1.1)	(−0.5 to 2.0)		
P-value[b]	<0.001	0.227		
TUG, before (seconds)				
Mean ± SD (range)	10.7 ± 2.9 (6.6–17)	9.8 ± 2.1 (6.2–14.5)	0.9 ± 0.7 (−0.5 to 2.3)	0.198[a]
TUG, after (seconds)				
Mean ± SD (range)	8.3 ± 2 (5.8–13.4)	9.7 ± 1.4 (7–12)	−1.3 ± 0.5 (−2.3 to −0.4)	0.007[a]
Within-group difference				
Mean ± SD	2.4 ± 1.8	0.1 ± 0.8		
95% CI	(1.7 to 3.1)	(−0.6 to 0.9)		
P-value[b]	<0.001	0.701		
GDS-15, before[c]				
Median (first–third quartile)	4 (1.8–6)	3.5 (2–7.3)	−0.7 (0.3 to 1.0)	0.543[d]
GDS-15, after[c]				
Median (first–third quartile)	2.5 (1–4)	4 (2–5.3)	−0.7 (0.5 to 1.1)	0.228[d]
Within-group difference				
Median (first–third quartile)	1.1 (1.0 – 6.0)	1.0 (2.0 – 6.8)		
95% CI	(0.9 to 2.3)	(0.6 to 1.7)		
P-value[e]	0.035	0.038		
Depressive symptoms, before[f]				
Yes	11 (42.3)	13 (50)	3 (7.7)	0.578[g]
Depressive symptoms, after[f]				
Yes	5 (19.2)	10 (38.5)	5 (19.3)	0.126[g]
Within-group difference				
n (%)	6 (23.3)	3 (11.5)		
P-value[h]	0.031	0.431		

[a]Student's *t*-test for independent groups assuming variance homogeneity.
[b]Student's *t*-test for matched data.
[c]Variable with asymmetric distribution.
[d]Mann–Whitney's *U*-test.
[e]Wilcoxon's test.
[f]Percentages obtained based on the total of each group and presented in n(%).
[g]Pearson's chi-square test with continuity correction.
[h]McNemar's test.
CI, confidence interval; BBS, Berg Balance Scale; TUG, Timed Up and Go Test; GDS-15, 15-item Geriatric Depression Scale (Yesavage version with 15 questions); depressive symptoms: absolute number of individuals (%) with a GDS-15 score ⩾5.

two groups. At the same time that the mean in the control group was reduced in the final assessment, the intervention group exhibited a significant increase. In the estimation of the effect size in the intra-group comparisons, we detected a large effect in the intervention group (Cohen's $d=0.93$; $P=0.001$) and a small effect in the control group (Cohen's $d=0.29$; $P=0.158$).

In the comparison of the Timed Up and Go Test score between the groups at the end of the study (Table 2), we observed a statistically significant difference, indicating a greater mean time in the control group in comparison with the intervention group. The intra-group comparison indicated a significant difference in the intervention group which, at the end of the study, exhibited a 22.4% reduction in the Timed Up and Go Test mean score in comparison with the initial mean, whereas the mean in the control group practically remained unchanged. We observed time-by-group interaction ($F(1,50)=20.64$; $P=0.002$; power=99.4%), confirming that the intervention group and the control group exhibited different variation between the initial and the final means. There was a large effect size in the intervention group (Cohen's $d=0.96$; $P<0.001$) and a small effect in the control group (Cohen's $d=0.06$; $P>0.999$).

The data obtained with the Geriatric Depression Scale were analyzed in two ways (Table 2), namely, comparison of the median scores obtained before and after the intervention; and the percentage of participants with scores indicative of depressive symptoms (Geriatric Depression Scale ⩾ 5). Independent of how the Geriatric Depression Scale data were analyzed, the between-group comparisons did not indicate statistically significant differences before or after the intervention. In addition, we did not observe time-by -group interaction ($F(1,50)=0.01$; $P=0.908$; power=5.1%). However, intra-group comparisons indicated a significant reduction in the intervention group's final median score, whereas the control group's final median score showed a significant increase. There was a small size effect both in the intervention group (Cohen's $d=0.47$; $P=0.037$) and the control group (Cohen's $d=0.36$; $P=0.043$). There was also a significant reduction in the percentage of participants with scores indicative of depressive symptoms in the intervention group at the end of the intervention, whereas the reduction in the control group was statistically irrelevant. This way, the reduction in the intervention group presented a large size effect (Cramer's $V=0.57$; $P=0.007$), whereas in the control group, the effect size was small (Cramer's $V=0.17$; $P=0.032$).

The mean frequency at the training sessions was 89.5% of the total 48 sessions. Among the 26 intervention group participants, two never missed the sessions, 11 missed between one and six, and the remaining half missed seven.

Discussion

This study found that older adults with mild cognitive impairment, who performed group exercises in the community centers of their own respective communities, improved their balance and mobility, and reduced depressive symptoms. However, in general terms, the older adults of the control group kept their initial scores unchanged.

At the beginning of the study, both groups presented Berg Balance Scale scores consistent with low risk of falls (⩾45 points).[18] This was an expected finding, as independence in daily-life activities was a definitive criterion for the diagnosis of mild cognitive impairment.[17] Furthermore, participants could not present a high risk of falling as they were expected to go independently from their homes to the place where the tests and the intervention occurred.

Nevertheless, as far as fall risk is concerned, the need for providing specific training to sedentary older adults with mild cognitive impairment is seen in the significant time-by-group interaction and the small effect size found in the analysis of the control group's balance data. This is particularly relevant as there is evidence that the prevalence of falls among them is twice that of cognitive intact older adults and this impairment can increase the risk for falls.[11] Furthermore, age-associated physiological losses are greater in mild cognitive impaired subjects[8] and they exhibit less balance control than those who keep their normal cognitive function.[8,22] One of the factors that may be related to this more expressive balance deficit in older adults with mild cognitive impairment is the marked modification that occurs in the contents of their white matter, besides other neuroanatomical changes in their brains compared to those cognitively normal.[8]

In addition to the improvement in balance, the intervention group also exhibited improvement in mobility. Despite being a simple and easily applied test, the Timed Up and Go Test can be seen as a sequence of different complex subtasks, including positioning, coordination, rotations, strength of lower limbs, and balance. Therefore, the improvement in the performance of these older adults in the Timed Up and Go Test not only means greater mobility, but also improvement in the integration of cognitive resources needed to perform the test.[23] This improvement in balance and mobility found in our study corroborates the findings of other researchers.[22,24]

Also relevant is the fact that the exercises were performed in group, as they can lead to the improvement in the social component of quality of life,[25] as well as cognitive function.[26] Furthermore, older adults without dementia who performed social activities more frequently exhibited reduced rates of decline in their global cognitive function.[27] These findings[25–27] emphasize the importance of conducting group exercises with older adults with mild cognitive impairment, as we did.

In order to guarantee high attendance, we telephoned every time a participant missed a training session and tried to schedule an extra one. This strategy was successful, as can be seen in the mean attendance rate (89.5%), but also in the intervention group low withdrawals (4/30). It is possible that this association of strategies led to the gradual creation of a bond which, in turn, led to greater consistency in training and may have positively influenced the gains of the intervention group.[28]

Although none of the groups achieved a median Geriatric Depression Scale score compatible with depression at any stage of the study, a great effect size was observed in the reduction of the number of intervention group participants whose scores were compatible with depressive symptoms. These findings become even more relevant when we consider that depressive symptoms are common in older adults with mild cognitive impairment and can increase the risk of dementia or accelerate its progression.[29] In addition, mild cognitive impairment may facilitate the occurrence of depression over time,[9] and, consequently, a shared etiology between neurodegenerative and psychiatric disorders has been suggested.[30]

Another aspect to be taken into consideration is that, generally, depression is treated with drugs.[9] However, only less than half of older adults with major depression achieve remission undergoing drug treatment. These data are even more worrying because cognitive impairment may prevent older adults from complying with treatments and affect other aspects that are fundamental to ensuring the success of any therapeutic measure.[9] This fact emphasizes the importance of promoting exercises in this population, given that older adults with mild cognitive impairment are more likely to exhibit symptoms of depression in comparison with those without.[30] Exercises and social contact can promote both functional—as confirmed by our results—and psycho-affective benefits,[30] which could prevent the emergence of depression and a possible accelerated progression to some form of dementia. In this sense, strength and aerobic exercises performed in group in the community represent an affordable, simple, and relatively low-cost means of preventing the development or worsening of depressive symptoms in older adults with mild cognitive impairment, particularly considering that they lead to the improvement of mood and executive function in this population group.[30]

A limitation of our study was the fact that it was impossible to blind participants or people delivering the intervention. Another limitation is the lack of a longer follow-up, which, for instance, would allow us to see if the intervention group gains would be maintained and for how long. A longer follow-up would also allow us to determine whether or not the losses presented by the control group would be accentuated or if those aspects, unchanged significantly over 6 months, would remain so.

A further limitation of our study is the fact that its sample did not achieve the necessary size to detect a significant between-group difference in the depressive symptoms data, according to the sample size calculations. Regardless of this, the significant reduction in the intervention group's median GDS score and the concomitant significant increase in the control group's, both findings with significant effect size, indicate the positive impact of the group exercises on the participants' mood, as well as the deterioration among those of the control group.

The main implication of our study for clinical practice and/or future research is that the designed group exercise protocol is a viable, low-cost way of helping maintain balance, mobility, and mood in a population otherwise more prone to lose physical and cognitive function[3] and develop depressive symptoms.[9] Moreover, the exercises can be carried out in relatively small places and monitoring the participants' progress is possible through the use of simple and easy-to-apply tests, such as those we adopted, which are also adequate for use where space is an issue. Another contribution from our study for clinical practice and/or future research is the successful strategies adopted for keeping the participants from forgetting to attend the exercise sessions and maintaining the necessary training volume. This is particularly relevant for longer periods of training, as it is more likely that other commitments will lead to missed sessions. Thus, programs must be designed with a degree of flexibility and/or compensation for those times when subjects cannot exercise, besides providing means of increasing bonding and commitment to continued attendance. In terms of future research, it would also be interesting to determine the effects of cognitive training used in conjunction with group exercise for this population, besides having a follow-up period.

Clinical messages

- Aerobic and strength group exercise undertaken in their own community improved balance, mobility, and depressive symptoms in older adults with mild cognitive impairment.
- This group exercise program is viable to incorporate in communities and could promote the health in older adults with mild cognitive impairment.

Acknowledgements

The authors would like to thank the generosity and commitment of the participants and their families, as well as the support from the primary healthcare units' teams and the Residents' Association. They are also thankful to the Conceição Hospital Group for allowing Chandra da Silveira Langoni time for her PhD studies.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Chandra da Silveira Langoni was awarded a PhD scholarship by CAPES. Thus, this study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nivel Superior - Brasil (CAPES) - Finance Code 001.

ORCID iD

Thais de Lima Resende https://orcid.org/0000-0002-8393-732X

References

1. Kaliman P, Párrizas M, Lalanza JF, et al. Neurophysiological and epigenetic effects of physical exercise on the aging process. *Ageing Res Rev* 2011; 10(4): 475–486.
2. Levasseur M, Généreux M, Bruneau JF, et al. Importance of proximity to resources, social support, transportation and neighborhood security for mobility and social participation in older adults: results from a scoping study. *BMC Public Health* 2015; 15: 503.
3. Kikkert LH, Vuillerme N, van Campen JP, et al. Walking ability to predict future cognitive decline in old adults: a scoping review. *Ageing Res Rev* 2016; 27: 1–14.
4. Deslandes A, Moraes H, Ferreira C, et al. Exercise and mental health: many reasons to move. *Neuropsychobiology* 2009; 59(4): 191–198.
5. Iliffe S, Kendrick D, Morris R, et al. Multicentre cluster randomised trial comparing a community group exercise programme and home-based exercise with usual care for people aged 65 years and over in primary care. *Health Technol Assess* 2014; 18(49): vii–xxvii.
6. Fortier MS, Hogg W, O'Sullivan TL, et al. Impact of integrating a physical activity counsellor into the primary health care team: physical activity and health outcomes of the physical activity counselling randomized controlled trial. *Appl Physiol Nutr Metab* 2011; 36(4): 503–514.
7. BorgesSde M, Radanovic M and Forlenza OV. Functional mobility in a divided attention task in older adults with cognitive impairment. *J Mot Behav* 2015; 47(5): 378–385.

8. Shin BM, Han SJ, Jung JH, et al. Effect of mild cognitive impairment on balance. *J Neurol Sci* 2011; 305(1–2): 121–125.
9. Wilkins VM, Kiosses D and Ravdin LD. Late-life depression with comorbid cognitive impairment and disability: nonpharmacological interventions. *Clin Interv Aging* 2010; 5: 323–331.
10. Song D, Yu DSF, Li PWC, et al. The effectiveness of physical exercise on cognitive and psychological outcomes in individuals with mild cognitive impairment: a systematic review and meta-analysis. *Int J Nurs Stud* 2018; 79(1): 155–164.
11. Lipardo DS, Aseron AMC, Kwan MM, et al. Effect of exercise and cognitive training on falls and fall-related factors in older adults with mild cognitive impairment: a systematic review. *Arch Phys Med Rehabil* 2017; 98(10): 2079–2096.
12. Brazilian Health Ministry. *The implementation of the family health unit*. Brasília: Ministério da Saúde, 2000 (in Portuguese), http://bvsms.saude.gov.br/bvs/publicacoes/implantacao_unidade_saude_familia_cab1.pdf (accessed 18 June 2018).
13. Langoni CDS, Resende TL, Barcellos AB, et al. Effect of exercise on cognition, conditioning, muscle endurance, and balance in older adults with mild cognitive impairment: a randomized controlled trial. *J Geriatr Phys Ther*. Epub ahead of print 4 May 2018. DOI: 10.1519/JPT.0000000000000191.
14. Carvalho AV and Caramelli P. Brazilian adaptation of the Addenbrooke's Cognitive Examination-Revised (ACE-R). *Dement Neuropsychol* 2007; 1(2): 212–216.
15. Shelky M and Wallace M. Katz index of independence in Activities of Daily Living (ADL). Try this: best practices in nursing care to older adults [serial on the Internet], 2012, https://consultgeri.org/try-this/general-assessment/issue-2.pdf (accessed 20 September 2017).
16. Pfeffer RI, Kurosaki TT, Harrah CH Jr, et al. Measurement of functional activities in older adults in the community. *J Gerontol* 1982; 37(3): 323–329.
17. Albert MS, DeKosky ST, Dickson D, et al. The diagnosis of mild cognitive impairment due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimer Dement* 2011; 7(3): 270–279.
18. Whitney S, Wrisley D and Furman J. Concurrent validity of the Berg Balance Scale and the Dynamic Gait Index in people with vestibular dysfunction. *Physiother Res Int* 2003; 8(4): 178–186.
19. Podsiadlo D and Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991; 39(2): 142–148.
20. Yesavage JA, Brink TL, Rose TL, et al. Development and validation of a geriatric depression screening scale: a preliminary report. *J Psychiatr Res* 1982–1983; 17(1): 37–49.
21. Fox SM 3rd, Naughton JP and Haskell WL. Physical activity and the prevention of coronary heart disease. *Ann Clin Res* 1971; 3(6): 404–432.
22. Jeon SY, Han SJ, Jeong JH, et al. Effect of exercise on balance in persons with mild cognitive impairment. *Neurorehabilitation* 2014; 35(2): 271–278.
23. Mirelman A, Weiss A, Buchman AS, et al. Association between performance on Timed Up and Go subtasks and mild cognitive impairment: further insights into the links between cognitive and motor function. *J Am Geriatr Soc* 2014; 62(4): 673–678.
24. Sherrington C, Whitney JC, Lord SR, et al. Effective exercise for the prevention of falls: a systematic review and meta-analysis. *J Am Geriatr Soc* 2008; 56(12): 2234–2243.
25. Madureira MM, Bonfá E, Takayama L, et al. A 12-month randomized controlled trial of balance training in elderly women with osteoporosis: improvement of quality of life. *Maturitas* 2010; 66(2): 206–211.
26. Suzuki T, Shimada H, Makizako H, et al. A randomized controlled trial of multicomponent exercise in older adults with mild cognitive impairment. *PLoS ONE* 2013; 8(4): e61483.
27. James BD, Wilson RS, Barnes LL, et al. Late-life social activity and cognitive decline in old age. *J Int Neuropsychol Soc* 2011; 17(6): 998–1005.
28. Öhman H, Savikko N, Strandberg TE, et al. Effect of physical exercise on cognitive performance in older adults with mild cognitive impairment or dementia: a systematic review. *Dement Geriatr Cogn Disord* 2014; 38(5–6): 347–365.
29. Peters ME, Rosenberg PB, Steinberg M, et al. Neuropsychiatric symptoms as risk factors for progression from CIND to dementia: the Cache County Study. *Am J Geriatr Psychiatry* 2013; 21(11): 1116–1124.
30. Taylor ME, Delbaere K, Lord SR, et al. Neuropsychological, physical, and functional mobility measures associated with falls in cognitively impaired older adults. *J Gerontol A Biol Sci Med Sci* 2014; 69(8): 987–995.