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The Effect of Combined Exercise Versus Aerobic Exercise on Cognition and Mood among Hypertensive Older Adults: Randomized Clinical Trial

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Abstract

Comorbidities such as hypertension is a risky factor to impair cognitive function in elderly. Both strength and aerobics (CT, combined exercise) or aerobics (AT) has potential benefits for healthy as well as hypertensive elderly. Our goal was to evaluate the effects of CT and AT on cognition and mood. 52 hypertensive older adults were randomized to 16 weeks of CT (n=26) or group control (GC) (n=26), after this period subjects in the CONTROL began AT (AT) for 16 weeks. Delta between post and pre were calculated and normality was tested. One-way ANOVA to compared groups (CT, AT and CONTROL) follow by post-hoc of by Hechberg and Kruskal-Wallis test followed by Mann-Whitney, for CT and GC or Wilcoxon for GC and AT, depending upon parametric assumption. Improvements in aerobics fitness for both CT and AT ($H(2) = 13.89$ $p<0.001$ and $p<0.001$), working memory ($H(2) = 10.07$, $p=0.02$ and $p=0.007$), speed processing ($H(2) = 10.51$, $p=0.004$ and $p=0.019$), and overall executive function ($F(2, 42) = 4.862$, $p=0.05$ and $p=0.01$) when compared to CONTROL. Improvement in depressive symptoms to CT ($H(2) = 18.08$, $p<0.001$) compared to CONTROL only and tendencies to improve short-term memory ($F(2, 47) = 3.26$, $p=0.06$) Both CT and AT improve cognitive functions (working memory, overall executive function, speed processing), only CT were able to modified depressive symptoms and short-term memory. Additional benefits for CT would be attached to social interaction, improvement in blood flow or IGF-I release.

Keywords: Aging; Exercise; Dementia; Combined exercise; Aerobic exercise

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Introduction

Dementia prevalence is expected to double or triple over the next generation [1-6], making identification of preventative strategies is crucial. Sedentary lifestyle and hypertension are risky factors which lead to cognitive problems and vascular dementia by deposition of β-amyloid, as well as white matter lesions, commonly named as silent brain lesions [7]. Exercise has potential benefits for hypertensive people [2].

Aerobic (AT) and resistance training (RT) may improve cognition and mood among older adults without healthy problems [4,5]. Combined training (CT) may have additive effects, as AT and RT may act through different pathways [1]. We compared 16 weeks of CT, AT on cognition and depressive symptoms among hypertensive older adults.

Methods

52 hypertensive older adults were randomized to 16 weeks of CT (n=26) or CONTROL (n=26) (www.braziliantrials.com, U1111-1181-4455); methods are detailed elsewhere [8]. CONTROL participants were invited to 16weeks of AT after the CONTROL period **(Figure 1).** Briefly, participants were ≥ 60 years, had hypertension, and did physical activity ≤ 2x/week. Participants provided written informed consent. The Ethics Committee at University of Campinas (CAEE 54943216.7.0000.5404) approved the study.

AT and CT participants completed 50min of AT 3x/week on a treadmill at a speed corresponding to 63% VO_2 max, as identified in a progressive maximum exercise test (VO_2peak). In 2 sessions/week, CT participants also did 15min of RT prior to AT, performing

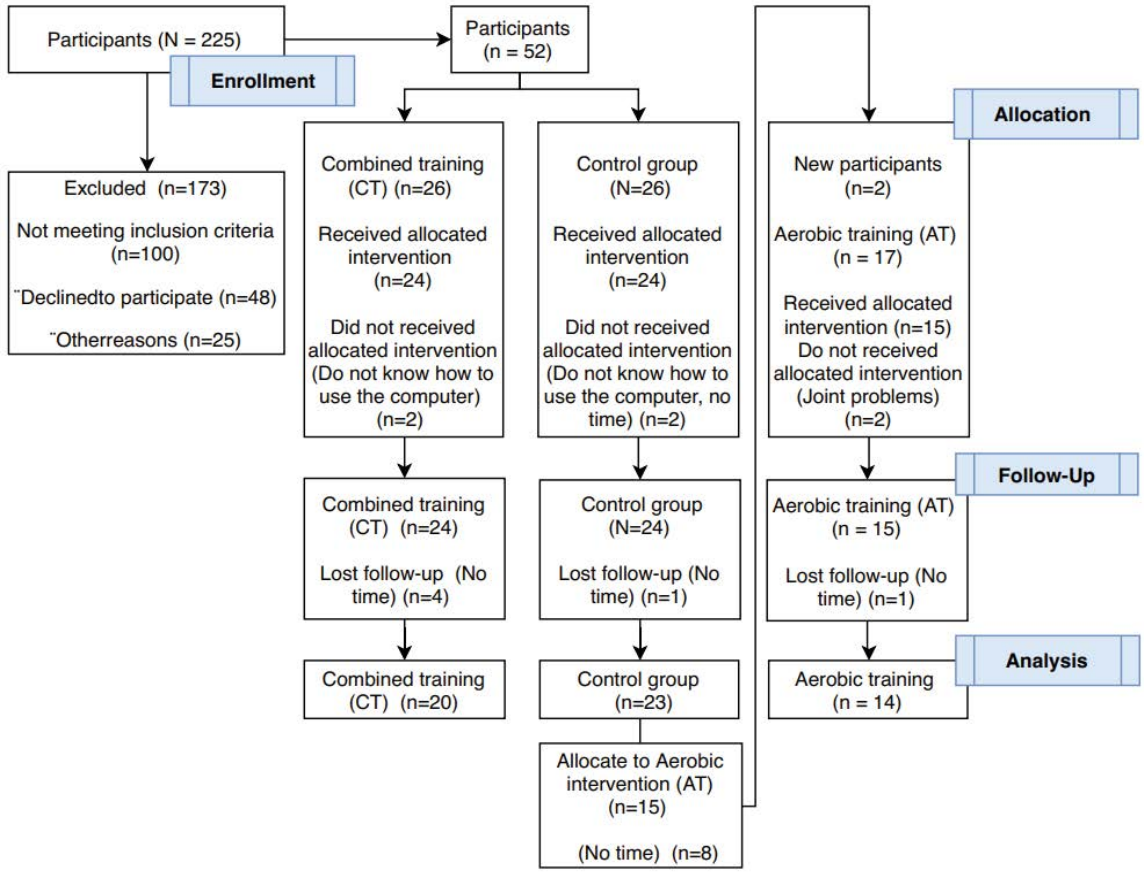

Figure 1 Flowchart of experimental.

15 repetitions of 6 exercises across major muscle groups at an intensity of 5-6 ("strong") on the 10-point Borg rating of perceived exertion scale. The CONTROL participants have maintained their baseline physical activity level.

Assessments were at baseline, 16 weeks, and 32 weeks (AT only). Short- and long-term memory were measured using Shopping List Test and working memory (errors to find the right pathway), inhibitory control (perseverative errors), and overall executive function (sum of scores) were assessed with the Groton Maze Task (Cog State), depression by Geriatric Depression Scale (GDS) and blood samples for BDNF analyses (Premixed Multiplex). Chi-square was used to compare categorical data. One-way ANOVA, followed by Hechberg post hoc was performed, or Kruskal-Wallis test followed by Mann-Whitney, for CT and GC or Wilcoxon for GC and AT, depending upon parametric assumption ($p<0.05$) (R Core team, Vienna, Austria).

Results

Twenty participants in CT and 23 in CONTROL completed the trial (Figure 1). From CONTROL, 15 agreed to participate in AT with an additional 2 recruited; 14 of 17 completed.

Table 1 shows baseline characteristics and changes over 16-weeks. Compared to CONTROL, CT and AT improved aerobic fitness ($H(2) = 13.89$ $p<0.001$ and $p<0.001$), working memory ($H(2) = 10.07$, $p=0.02$ and $p=0.007$), speed processing ($H(2) = 10.51$, $p=0.004$ and $p=0.019$), and overall executive function ($F(2, 42) = 4.862$, $p=0.05$ and $p=0.01$). CT also improved depressive symptoms ($H(2) = 18.08$, $p<0.001$) and neared significance for short-term memory ($F(2, 47) = 3.26$, $p=0.06$) compared to CONTROL; participants in AT kept unchanged to CONTROL for depressive symptoms ($H(2) = 18.08$, $p< 0.73$) and short-term memory ($F(2, 47) = 13.67$, $p=0.99$).

Discussion and Conclusion

Among hypertensive older adults, 16 weeks of AT or CT improved executive function and speed processing. CT also improved depressive symptoms and neared significance for short-term memory, whereas AT did not, providing evidence that CT may be more beneficial for mental health in aging.

There are several reasons for which CT may carry more benefits. One study suggests that RT acts through an IGF-1 pathway, whereas AT acts through a BDNF pathway [1]. CT stimulates pathways, inducing more brain changes even though, no changes in BDNF levels. Improvements in CF for CT lays in social engagement hypothesis, since AT has less human contact and did not improve depressive symptoms and short-term memory [3].

In conclusion, our study suggests that both AT and CT are beneficial to cognitive function. Additional benefits can be achieved by CT, on memory because possibly by human contact.

Table 1 Baseline characteristics and changes in outcomes over 16-week period, expressed as mean (SD) or % (n).

	CT (N =20)	AT (N=14)	CONTROL (N=23)	p-value
Baseline				
Age	64.9 (4.3)	67.9 (6.1)	66.3 (5.5)	0.13
Gender, % women	70 (14.0)	64 (9.0)	60 (14)	0.92
Age	64.9 (4.3)	67.9 (6.1)	66.3 (5.5)	0.13
Height (m)	1.5 (0.1)	1.5 (0.1)	1.5 (0.1)	0.37
Weight (kg)	78.8 (12.6)	73.7 (9.8)	78.9 (11.2)	0.07
BMI	29.1 (4.2)	28.8 (4.3)	30.3 (3.3)	0.13
SBP (mmHg)	133.5 (17)	134.1 (12.6)	134.9 (24.4)	0.45
DBP (mmHg)	87.2 (10.6)[a]	75.6 (9.7)	82.9 (12.2)	**0.01**
MMSE (0-30)	24.9 (2.7)	25.8 (2.5)	26.2 (2.6)	0.08
Years of study	10.8 (4.5)	10.4 (4.8)	11.2 (4.1)	0.73
GDS (0 - 15)	4.4 (2.9)	2.0 (1.1)	3 (2.58)	0.49
Change over 16weeks on Cognition				
Working memory (GM RER)	-2.76 (6.9) [b]	-2.77 (4.7) [c]	2.32 (4.0)	**<0.001**
Inhibitory control (GM PER)	-0.24 (0.9)	-0.08 (0.3)	-0.05(0.2)	0.80
Overall Executive function (GM TER)	-3.47 (7.9) [b]	-5.18 (4.5) [c]	1.71 (5.2)	**0.01**
Short-term memory (SL3)	1.53 (2.4) [d]	-0.08 (2.1)	0 (1.7)	**0.04**
Long-term memory (SLR)	0.71 (2.2)	-0.08 (2.1)	-0.12 (1.6)	0.13
Speed processing (Time I)	-0.22 (0.3) [b]	-0.25 (0.3) [b]	0.07 (0.2)	**<0.001**
Change over 16weeks on mechanics behind cognitive function changing				
VO2 (ml/kg/min)	2.87 (3.4) [b]	2.63 (2.1) [c]	-0.38 (2.3)	**<0.001**
BDNF (pg/dL)	-1129.86 (4289.2)	588.6 (3316.9)	943.62 (6203.4)	0.42
GDS (0-15)	-2.79 (2.2) [a, b]	-0.09 (0.7)	0.05 (1.6)	**<0.001**

BMI: Body mass index; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; MMSE: Mini-mental state exam; VO2: Maximal oxygen consumption; GML-RER: Groton maze learning rule break; GML-PER: Groton Maze learning perseverance error; GML-TER: Groton maze learning total error; ISL3: International shopping list third stage; ISRL: International shopping list latter recall; GDS: Geriatric depression scale.
a Significant difference between CT and AT;
b Significant difference between CT and Control;
c Significant difference between AT e Control;
d Trends to difference between CT and Control.

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