International Journal of Gerontology 10 (2016) 28–32

Contents lists available at ScienceDirect

International Journal of Gerontology

journal homepage: www.ijge-online.com

Original Article

Resistance Training, Lipid Profile, and Homocysteine in Patients with Alzheimer's Disease☆

Thays Martins Vital [1] *, Salma S. Soleman Hernandez [1], Angelica Miki Stein [1], Marcelo Garuffi [1], Camila Vieira Ligo Teixeira [1], Ruth Ferreira Santos-Galduroz [1, 2], José Luiz Riani Costa [1], Florindo Stella [1, 3]

[1] *Institute of Biosciences, UNESP, Universidade Estadual Paulista, Physical Activity and Aging Laboratory (LAFE), Rio Claro,* [2] *Center of Mathematics, Computing and Cognition, UFABC, University Federal of ABC, Santo André,* [3] *Geriatric Psychiatry Clinic, UNICAMP, Universidade Estadual de Campinas, Campinas, SP, Brazil*

A R T I C L E   I N F O

Article history:
Received 25 December 2013
Received in revised form
3 April 2014
Accepted 8 August 2014

Keywords:
cholesterol,
dementia,
exercise,
homocysteine,
physical activity

S U M M A R Y

Background: The aims of this study were to verify the relation of the level of physical activity with the lipid profile and the homocysteine and to investigate the effects of resistance training on the concentrations of metabolic variables of patients with Alzheimer's disease.
Methods: Initially, the sample consisted of 37 community-dwelling patients with Alzheimer's disease. Eventually, only 30 patients participated in the intervention protocols offered, and they were divided into two groups: a training group with 14 patients and a social interaction group with 16 patients. All patients were evaluated using several instruments. We also analyzed the levels of serum homocysteine and lipid profiles.
Results: There were no significant relations between level of physical activity, lipid profile, and homocysteine. The training group exhibited reduced total cholesterol and low-density lipoprotein (LDL), as well as increased concentrations of high-density lipoprotein (HDL). However, the social interaction group exhibited decreased total, LDL, and HDL cholesterol. There were no significant differences in the homocysteine concentrations for the two groups.
Conclusion: No relationships were found between physical activity and metabolic variables. For both groups, changes were observed in the concentrations of total, LDL, and HDL cholesterol.

1. Introduction

Homocysteine is a sulfur-containing amino acid derived from methionine. Homocysteine is an intermediate metabolite of the biosynthetic pathway that converts methionine to cysteine[1].

Elevated concentrations of homocysteine are defined as constituting hyperhomocysteinemia. Changes in lipid profiles and hyperhomocysteinemia may be related to Alzheimer's disease (AD) and may also be associated with increased cognitive decline[2–7], especially in executive functions[8]. These concentrations may increase in cases of AD, depending on the evolution of the disease[9].

The literature includes controversial reports about the relationship between dyslipidemia and cognitive impairment, and the process of the formation of beta-amyloid and neurofibrillary tangles, which are classical markers of AD[6,9–15].

Given the possibility of these changes further worsening the clinical pictures of patients with AD, pharmacologic treatment has been combined with nonpharmacologic interventions such as physical activities to control the changes that arise from AD[16–20].

There is evidence that physical activity can modulate some of the peripheral risk factors that are related to dyslipidemia and indirectly improve brain function[21]. The data concerning physical activity and the modulation of homocysteine levels remain controversial[22].

☆ Conflicts of interest: All the authors assume that they have no financial interests related to the material described in this manuscript. There are no conflicts of interest.

* Correspondence to: Dr Thays Martins Vital, Avenue 24 A, number 1515, Bela Vista, Rio Claro 13.506-900, SP, Brazil.
E-mail address: thaysmv@yahoo.com.br (T.M. Vital).

http://dx.doi.org/10.1016/j.ijge.2014.08.003

A review study conducted by Hurley et al[23] showed that resistance training can reduce the risk of metabolic syndrome, including dyslipidemia. Liu-Ambrose and Donaldson[24] found that resistance training reduces homocysteine concentrations in humans. Studies on elderly people who do not have cognitive impairments emphasize that resistance training is an important ally in improving lipid profiles and decreasing concentrations of serum homocysteine[25,26].

Few studies have investigated the effect of physical activities on the modulation of concentrations of homocysteine and lipid profiles in patients with AD. It is unknown which intensities, frequencies, and volumes of resistance training for controlling lipid and homocysteine concentrations are best. The aims of this study were to verify the relation of the level of physical activity with the lipid profile and homocysteine, and to investigate the effects of resistance training on the concentrations of homocysteine and the lipid profiles of patients with AD.

2. Materials and methods

2.1. Sample

Initially, the sample consisted of 37 community-dwelling patients. All of the patients were participants in the Programa de Cinesioterapia Funcional e Cognitiva para Idosos com Doença de Alzheimer[27].

The inclusion criteria were as follows: clinical diagnosis of AD according to the Diagnostic and Statistical Manual of Mental Disorders, 4th ed., Test Revised (DSM-IV-TR)[28], and AD in mild or moderate stage, as assessed by the Clinical Dementia Rating Scale[29,30].

Overall, only 30 patients participated in the intervention protocols offered, and these patients were divided into two groups: the training group (TG; $n = 14$ patients) and the social interaction group (SIG; $n = 16$ patients). The groups were divided in order to comply with a similar distribution with respect to age, sex, education, and medical condition.

2.2. Methodological procedures

Clinical and sociodemographic data were obtained by asking the caregivers to undergo a structured interview. In order to characterize the cognitive profile, we used the Mini-Mental State Examination[31].

To verify the level of physical activity, we used the Baecke Questionnaire Modified for the Elderly[32].

The patients were referred to a clinical laboratory in the city of Rio Claro where they underwent laboratory tests for the purpose of verifying their metabolic profile (total cholesterol and fractions, triglycerides, and homocysteine). The procedures for blood collection followed the recommendations of the Brazilian Society of Clinical Pathology/Laboratory Medicine. Blood collection was performed at baseline and after 16 weeks of intervention.

The research project was approved by the Ethics Committee of the institution and was assigned protocol number 4827. The patients' caregivers signed a consent form, and this form was also approved by the Ethics Committee. This was performed in accordance with the rules established by resolution 196/96 of the National Health Council for research involving human beings.

2.3. Training protocol and social interaction group

The training protocol and the SIG were described by Garuffi et al[33].

The training program consisted of 16 weeks of activities that were carried out three times a week on nonconsecutive days. Each session lasted 60 minutes.

The patients performed five resistance exercises. The training sessions were held to 85% of the maximum load encountered during the test of maximum repetitions. During each exercise, the participants performed three sets of 20 repetitions with 2 minutes of recovery between sets and between exercises[33].

The SIG protocol lasted for 16 weeks; the participants met three times a week on nonconsecutive days, and had sessions that lasted 60 minutes.

The activities that this group engaged in included manual activities, drawing, writing, group dynamics, relaxation, musical activities, ecological tours, and other activities[33].

2.4. Statistical analysis

The statistical analysis involved applying the Student *t* test to determine whether there were differences between the two groups at baseline, and repeated two-way measurements analysis of variance (ANOVA) was performed to evaluate the effects of the experimental protocols. Analysis of covariance was used to verify if the level of physical activity (confounding variable) influenced the metabolic variables. Chi-square analysis was used to verify the differences between pre and post moments for the groups with hyperhomocysteinemia and without hyperhomocysteinemia. Data were expressed in terms of means and standard deviations. The Spearman correlation test was used to analyze the relation between level of physical activity, lipid profile, and homocysteine. The level of significance was a set at 5% for all of the analyses.

3. Results

The demographic details of the 37 community-dwelling patients with AD were as follows: mean age, 78.8 ± 7 years; educational level, 4.4 ± 3.6 years; level of physical activity, 3.2 ± 2.9 points. Of these 37 patients, 12 (32.43%) had hyperhomocysteinemia, which was determined by using a cutoff score of 15 μmol/L[34].

The Spearman correlation coefficients did not find any significant relationship between level of physical activity, lipid profile, and homocysteine.

The results were analyzed using appropriate statistical procedures. It was determined that there were no statistically significant differences between groups at baseline after taking into account covariates such as age, educational level, disease duration, overall cognitive profile, sex, and disease stages, except for the level of physical activity. The characterization data for the TG and the SIG sample are shown in Table 1.

Table 1
Sociodemographic, clinical, and cognitive characteristics of patients in the training group (TG) and social interaction group (SIG).

Characteristics of the sample	TG	SIG	*p*
Age (y)	78.5 ± 7.7	79.9 ± 5.7	0.5
Educational level (y)	5.8 ± 4	4.1 ± 2.8	0.2
Disease durations (mo)	34.6 ± 26.1	25.9 ± 38.2	0.08
MMSE (points)	18.4 ± 4.6	17.6 ± 4.8	0.6
Levels of physical activity (points)	6.4 ± 2.1	1.8 ± 2.4	0.0*
CDR 1, *n* (%)	10 (71.42%)	13 (81.25%)	—
CDR 2, *n* (%)	4 (28.58%)	3 (18.75%)	—
Males, *n* (%)	3 (21.43%)	4 (25%)	—
Females, *n* (%)	11 (78.57%)	12 (75%)	—

*$p < 0.05$.
CDR = Clinical Dementia Rating; MMSE = Mini-Mental State Examination.