REVIEW ARTICLE

Preserving Motor Abilities Through Functional Stimulation In Institutionalized Elderly With Probable Alzheimer's Disease

David Paulo Ramalheira Catela; Maria Aucineia Ferreira; Marco António Colaço Branco

Abstract

Objective: The aim of the present study was to examine the effect of a program of functional motor stimulation in institutionalized elderly with probable Alzheimer's disease.

Methods: Participants were 60 elderly, divided in three groups: Normal Aging (SA) (n = 13), autonomous and non-institutionalized; Probable Alzheimer Without Intervention (CASI) (n = 18), institutionalized and not actively involved in the program; and, Probable Alzheimer With Intervention (CACI) (n = 29), institutionalized and actively involved in the program. Diagnosis of probable Alzheimer's disease (AD) was confirmed through medical report, and subjects were classified according to the Clinical Dementia Rating scores. Finger-tapping test (FTT) was administered for index finger of the preferred hand. The program had a duration of 12 sessions, 2 per week, and was conducted at the nursing homes.

Results: SA performance was higher than the remaining groups and the normal one for these ages. From the pre to the posttest, the CASI lowered their performance, but the CACI improved theirs and became more homogeneous. While the CACI maintained a performance not significantly different to SA in the pretest, the CASI revealed a significantly lower performance than the SA, in both test moments. In addition, whereas in the pretest the CACI did not differ significantly from the CASI, in the posttest they tended to display an improvement in performance.

Conclusion: The functional motor stimulation program allowed elderly with AD to preserve their speed in a task of fine motor coordination, measured by the FTT.

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Introduction

Alzheimer's disease (AD) is a progressive and irreversible neurodegenerative disorder characterized by functional motor decline, affecting basic activities of daily life.[1] Functional decline is a major risk factor for hospitalization,[2] and results in greater costs in health expenditures.[3] However, significant monthly savings in formal services are possible if disease progression can be slowed.[4]

Despite profound memory disorder, a person with mild-to-moderate AD is able to learn and retain motor and perceptual skills,[5–8] and can preserve efficiency on functional motor performance after receiving a training program[9]; eg, Rolland et al[10] submitted elderly patients with AD to an activity consisting of walking, stretching, balance and flexibility, held twice a week for one hour; and concluded that they had a smaller decline in the performance of everyday activities and better performance in walking and balance tasks compared to those not participating in the program.

Motor slowing is a predictor of functionality loss, as indicated by finger-tapping speed and walking speed measurements,[11] and slow motor speed has been shown to be a risk factor for causing fractures during falls.[12] In the moderate-stage of senile dementia of the Alzheimer type, walking speed and stride length are significantly lower

than in the mild-stage patients.[13] One common assessment of motor speed is the finger-tapping test (FTT). The FTT is frequently used as part of a neuropsychological examination to detect both motor and cognitive impairments. This test is typically scored as the average number of times a patient can depress a key with his or her index finger, on a manual finger-tapping device over a period of 10 s. The test normally consists of 5 tapping trials.[14] The FTT has been used for assessment of motor slowing related to AD.[15,16] This type of testing is useful in patients with mild cognitive impairment, who are at greater risk to convert to AD.[17] Elderly subjects usually perform 3 to 4 taps per second, with the dominant hand.[18]

Exercise increases fitness, physical function, cognitive function, and positive behavior in people with dementia.[19] However, to preserve motor coordination, motor activity programs may be more relevant for people with AD, living in nursing homes, as they spend prolonged protracted periods,[20] consequently, with a high rate of functional decline.[21] The aim of this study was to determine whether a functional motor stimulation program would delay motor functionality decline in elderly people with probable mild to moderate AD, living in nursing homes.

Methods

Participants

From the same location, a medium sized town of the center of Portugal, participants were 60 elderly subjects, divided in three groups, as follows: (1) Normal Aging (SA) (n = 13, 6 women, 75.85 ± 8.80 years old, CDR- 2.04 ± 2.66, Md = .75) - autonomous, living at home, with no history or evidence of neurologic or psychiatric disorder, (2) With Alzheimer Without Intervention (CASI) (n = 18, 16 women, 81.67 ± 4.73 years old, CDR- 15.39 ± 3.93, Md = 18.0) – institutionalized, with the diagnosis of probable senile dementia of the Alzheimer type, that systematically rejected to participate in the sessions of the program; and, (3) With Alzheimer With Intervention (CACI) (n = 29, 21 women, 82.03 ± 7.90 years old, CDR- 14.02, Md = 16.0) - institutionalized, with the diagnosis of probable senile dementia of the Alzheimer type, in mild to moderate stages of dementia, e.g., with impairments of anterograde and retrograde memory, in temporal orientation, need in supervision in daily life; yet preserving social graces and the ability to cooperate and follow instructions in activity sessions. Wheelchair users were included. The elderly subjects with probable AD belonged to three legalized nursing homes. Participants maintained their medication.

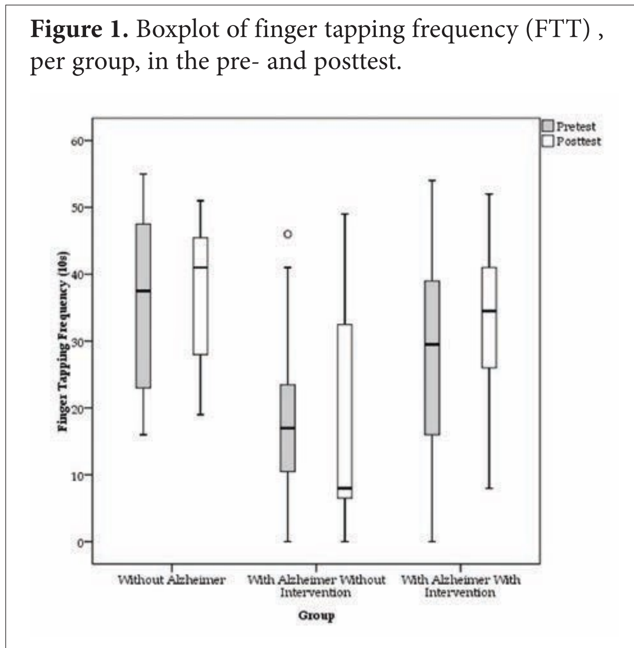
Protocols and Procedures

Diagnosis of probable AD was confirmed through medical report. Participants were classified of mild and moderate stages of the disease, according to the Clinical Dementia Rating scores,[22–24] that were determined by interviews with subjects and collateral informants who provided information on cognitive and functional status. Cognitive impairment was defined by a Clinical Dementia Rating Scale (CDR) score of 5 or more.

FTT was used for the index finger of the preferred hand, in a single trial of 10 seconds, due to motor skills difficulties of AD participants in repeating the task. Handedness was determined from patient self-report. The protocol for finger tapping counting was as follows: (1) considered a finger beat - when there is visible movement of the index finger in one or more of the following conditions: (i) even if there are lateral or circular movements during the upward and downward movement; (ii) isolated or followed by the remaining fingers; (iii) even if there is no contact with the surface of the table, but there is a continuous upward and downward movement, even if it is not continuous, eg, with brief tremors or oscillations; (iv) when there is no elevation of any of the remaining fingers or the hand, but there is elevation of the index finger; (v) even if the pulp of the finger is not in contact with the surface of the table, but there is a visible elevation of the index finger; and, (2) not considered a finger beat: when there is no visible movement of the index finger; when the pulp of the finger does not lose contact with the surface of the table, even if there is visible flexion of the interphalangeal joints of the index finger; when there is an elevation of the hand, but no elevation of the index finger; and/or, when using other fingers as a support and lever to raise the index finger. The protocol had a face validation by a panel, composed of one expert in Movement Sciences, one expert in Geriatrics, and one expert in Biomechanics. Panel members analyzed videos until consensus was reached.

With a quasi-experimental non-equivalent group design, the program was approved by Polytechnic Institute of Santarém Ethics Committee, and conformed to the Helsinki declaration. The program had a duration of 12 sessions, 2 per week, with a duration of 30 to 45 min per session, according to participants' capacity to respond. The first 6 sessions focused on personal space - body schema (eg, identifying parts of the body), laterality (eg, buttoning), spatial orientation (eg, placing over or under), mimics (eg, pretending to use tableware), fine motor and visuomotor coordination (eg, doing puzzles), visual and tactile perception (eg, guessing and naming unseen touched daily life objects); and, the last ones also on peripersonal and extrapersonal space - locomotion (eg, carrying and stowing empty boxes), amplitude of motion (eg, placing empty boxes on raised shelves), and dynamic balance (eg, throwing and catching balloons). Participants' guardians signed an informed consent form approved with the research project, and elderly assent (in each session) was obtained. SA subjects as well as relatives of the subjects with probable AD were given both written and oral information about the study. The program was conducted at the nursing homes.

Figure 1. Boxplot of finger tapping frequency (FTT) , per group, in the pre- and posttest.



Statistical Analysis

Normality of distributions was assessed by means of Shapiro–Wilk test. Kruskal-Wallis test (H) was used for between-group comparisons, with effect size (η^2_R) estimation and epsilon-squared estimate of effect size (ε^2_R), followed by Mann-Whitney test (z), with Bonferroni correction, and effect size r estimation. Wilcoxon test (t), with effect size r estimation, was used for within-group comparisons. The level of significance was set at $P < .05$.

Results

On the pretest, SA mean beats per second (bps) (3.64 ± 1.31, Md = 4.2) were the normal for these ages (18), and higher than those of the CASI (2.18 ± 1.82, Md = 1.8) and of the CACI (2.85 ± 1.55, Md = 3.0). There was a significant difference between-groups (H(2) = 6.684, $P < .05$; $\eta^2_H = .08$, $\varepsilon^2_R = .11$), with significant difference between SA and CASI ($z = 6.684$, $P = .013$, r = .45), but not between SA and CACI ($z = 1.497$, ns, r = .23), or between CASI and CACI ($z = 1.544$, ns, r = .23).

From the pre- to the posttest, the SA and the CASI maintained their performance (3.76 ± 1.00, Md = 4.1, $t = .708$, ns, r = .20; 2.08 ± 1.76, Md = 1.3, $t = .414$, ns, r = .10, respectively), but the CACI tended to improve theirs and became more homogeneous (3.31 ± 1.15, Md = 3.5, $t = 1.747$, $P = 0.08$, r = .34).

Results of the posttest, also demonstrate a significant difference between-groups (H(2) = 7.756, $P < 0.05$; η^2_H =.11, $\varepsilon^2_R = .14$), again with significant difference between SA and CASI ($z = 2.393$, $P = .017$, r = .44), and also without significant difference between SA and CACI ($z = 1.238$, ns, r = .19), but with a tendency for significant difference between CASI and CACI ($z = 2.191$, $P = .028$, r = .34).

Discussion

Elderly subjects with AD who took part in the functional motor stimulation program preserved and bettered their speed in a task of fine motor coordination, measured by the FTT.

Contrary to the majority of interventions performed on elderly subjects with AD, the implemented program had its contents based on motor activity and on functional tasks, instead of physical activity.[25] The reason for this option is based on the fact that AD is neurodegenerative, and, although physical exercise implies the involvement of neural mechanisms, it acts predominantly on physical and physiological systems. AD is basically a degenerative process of neural populations and of neurotransmitters, so, our proposition is what elderly with AD predominantly need is motor activities that stimulate coordinative capacities, like, rhythm, balance and spatial orientation, and, perceptual-motor mechanisms, like interception of objects and detection of affordances; because they require great involvement of the nervous system. Additionally, functional tasks, like walking for cleaning or laying the table (instead of mechanical physical exercises, like walking on a treadmill or doing stretching exercises), may allow, not only the involvement of procedural memory, but also of episodic memory,[26,27] in essential tasks for daily life autonomy; particularly, if motor tasks are conducted in contexts similar to the history of an AD person, eg, dancing with music of his/her time; as it was conducted in our program.

Considering the limited duration and frequency of the intervention, the results are promising and encourage the implementation of longer and better-adjusted programs for the various stages of the disease.

Apparently, the use of a very simplified version of FTT resulted, reinforcing its usefulness as a measuring instrument for this population. This test is non-invasive and inexpensive, and it is easy to understand and perform by AD persons, in one type of motor behavior that is affected in the early stages of the disease. Cyclical movements, like the one in the finger-tapping test, have the additional advantage of affording non-linear analysis,[28] more focused in the process of motor action.

Author Disclosure Statement

The authors declare no conflict of interest that may be inherent in their submissions.

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