Methods & Protocols

Protocol of group therapeutic exercises of people with Alzheimer's Disease

Protocolo de exercícios terapêuticos em grupo para pessoas com doença de Alzheimer

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ABSTRACT | INTRODUCTION: Aging generates several biological changes that give rise to diseases such as Alzheimer's Disease (AD) that can result in the functionality of the elderly. **OBJECTIVE:** To verify the effect of a physical therapy exercise program on the health of elderly people with AD. **MATERIALS AND METHODS:** A longitudinal study was carried out in elderly people with AD who attended a Day Care Center. Participants were selected using demographic characteristics and health conditions. For the analysis of the outcome variables, the pre and post intervention were evaluated with the tests: Timed Up and Go (TUG), Box and Blocks, Berg Scale and Functional reach in standing and sitting. Then they underwent a group intervention protocol divided into three phases: the preparatory phase, the active phase and the cooling down phase. Paired T-Student Test and Pearson's correlation were used for statistical analysis. Confidence Interval (CI) was established and p <0.05. **RESULTS:** We performed 28 sessions, with 11 elderly women, mean age of 88 (± 4) years, weekly attendance at the Center on Day 4 (± 1) times and mean score on the MMSE of 12 (± 5). They obtained statistical significance in the Seated Reach test pre 22.3 (± 10.4) and post 28.2 (± 9.0), with p = 0.003 and, in the TUG test pre 16.9 (± 5.8) and powders 2.5 (± 3.9), with p = 0.009. In addition, the Berg and TUG test showed a negative correlation, classified as good p = 0.020. **CONCLUSION:** The proposed protocol contributed to the improvement in functional health observed in the increase in the functional range and mobility of the elderly.

KEYWORDS: Alzheimer Disease. Physical therapy modalities. Exercise therapy. Aged.

RESUMO | INTRODUÇÃO: O envelhecimento gera diversas alterações biológicas que dão origens a condições de saúde como a Doença de Alzheimer (DA) que pode prejudicar a funcionalidade dos idosos. **OBJETIVO:** Verificar o efeito de um programa de exercícios fisioterapêuticos sobre a saúde dos idosos com DA. **MÉTODOS:** Foi realizado um estudo longitudinal, em idosos com DA frequentadores de um Centro-Dia. Os participantes foram selecionados por meio de características demográficos e condições de saúde. Para análise das variáveis de desfecho foram avaliados pré e pós intervenção com os testes: *Timed Up and Go* (TUG), Caixa e Blocos, Escala de Berg e Alcance funcional em pé e sentado. Em seguida foram submetidos a um protocolo de intervenção em grupo dividido em três fases: fase preparatória, fase ativa e fase de desaquecimento. Utilizou-se para análise estatística o Teste *T-Student* Pareado e a correlação de Pearson. Foi estabelecido Intervalo de Confiança (IC) e p<0,05. **RESULTADOS:** Foram realizadas 28 sessões com 11 idosas, com idade média de 88 (± 4) anos, frequência semanal no Centro Dia de 4 (± 1) vezes e pontuação média no MEEM de 12 (± 5). Obtiveram significância estatística no teste Alcance Sentado pré 22,3 (±10,4) e pós 28,2 (±9,0), com p = 0,003 e, no teste de TUG pré 16,9 (±5,8) e pós 2,5 (± 3,9), com p = 0,009. Além disso, o teste Berg e TUG apresentaram correlação negativa, classificada como boa p= 0,020. **CONCLUSÃO:** O protocolo proposto contribuiu para melhora na saúde funcional observadas no aumento do alcance funcional e da mobilidade das idosas.

PALAVRAS-CHAVE: Doença de Alzheimer. Modalidades de fisioterapia. Exercício terapêutico. Idoso.

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Introduction

Aging is a dynamic and progressive process marked by morphological, functional, biochemical and psychological modifications that result in the loss of adaptation capabilities of subjects toward their environment - senescence. This implies greater vulnerability, reduction of functional capability and, consequently higher incidence of diseases – senility[1]. With the demographic transition phenomenon there is an estimative that the world will have 253 million elderly people in 2050 and a life expectancy of 88 years of age[2]. This fact has increased the concernment about maintaining the functional capability of this population[3].

The degeneration of the central nervous system is one of the biological alterations giving rise to Dementias. The Alzheimer Disease (AD) is the most common of them being 0.7% more prevalent from 60 to 64 years of age and around 40% in age groups ranging from 90 to 95 years old[4]. It is characterized by synaptic degeneration, neuronal loss, senile plaques deposits in the cerebral cortex and neurofibrillary tangles. AD presents insidious onset[5] and mild cognitive impairment associated with alterations in gross motor coordination. In later stages the cognitive and motor impairment is worsened showing a significant reduction of functional skills[6].

Research studies have shown the beneficial results of regular physical activity practice for cognitive functions and functional capabilities in elderly people suffering from dementia[7]. It acts directly by increasing cognitive processing speed for improving the cerebral circulation and altering the synthesis and degradation of neurotransmitters promoting changes in the cerebral structures enabling to improve agility, balance and walking performance[4].

Urging to provide better life standards for elderly people suffering from AD, Adult Day Care Centers, named in Brazil Centros-Dia, were proposed to offer during the day some personal care, additional to what is already offered by their families. Toward that, the Association of Relatives and Friends of the Elderly (AFAI - Associação dos Familiares e Amigos dos Idosos) was created in 2005. It is a non-profitable institution with integrative approaching - social, health and wellbeing concerning the family and the elderly suffering from AD through multi-professional assistance.

Facing the new demographic scenario and repercussions over the assistance been rendered to the elderly diagnosed with AD, a question was raised: Do elderly people suffering from AD and performing a physiotherapy protocol present functional improvements in health? To answer the research question, it became relevant to elaborate and apply a physiotherapy exercise protocol about the functional health in elderly suffering from AD.

Methods

Ethical Aspects

This project was submitted to the Plataforma Brasil, CAAE: 92458518.4.0000.0084 and it was approved under the number 2.886.421. After that, the partner institution was contacted as well as all representatives of the participants selected to take part of the study, according to the objectives of this research. They received all the information needed and their doubts were cleared up before confirming their participation by signing the Informed Consent Forms (ICF). After the consent was signed by the representatives, the elderly participants were asked to participate by the Informed Assent Forms (IAF) and data were collected from those agreeing to take part of it.

Allocation of Participants

All the participants are regularly assisted by an Adult day care center in the city of São Paulo, a partner of the University - the headquarter of this research study.

The participants included in this research were elderly people of 60 years old or older, of both genders who had been diagnosed as mild or moderate AD and had enough cognitive capability to understand the required tasks. They should have attended the Adult Day Care Center at least 2 times per week and not present associated comorbidities that could impair their mobility.

Procedures

A longitudinal intervention study was carried out through a physiotherapy exercise protocol.

The first part of the study contemplated the selection of participants, by assessing their records and evaluating their mental condition. The collected data used for characterizing the sample were: a) confirmation of medical AD diagnosis; b) demographic characteristics (gender, age, date of birth, education level, frequency of assistance per week, health conditions and functional independence); c) nutritional profile of the elderly (weight, height, BMI, measures of circumferences). The mental condition of the selected elderly was evaluated by the Mini Mental State Examination scale (MMSE).

The MMSE is composed of several questions grouped in 7 categories, each of them aiming to evaluate specific cognitive "functions": time orientation, place orientation, registration of 3 words, attention and calculation, recall of the 3 words mentioned, language and visual construction cognitive domain. The score ranges from 0 to 30 points, where score 27 or higher means no cognitive impairment, between 21 and 24 points representing mild cognitive impairment, score 20 to 10 means moderate cognitive impairment and score 09 or lower means severe cognitive impairment[8].

The participants were submitted to pre and post intervention evaluations in a single day to verify the outcome variables by the:

i. Assessment of psychomotor function including reaction time, movement time and speed of performance by the Timed Up and Go (TUG) test and the Box of Blocks test.

The TUG test was carried out to assess their functional mobility and speed of performance was recorded. The elderly participants were oriented to stand up from a backrest chair, walk three meters, turn around, walk back to the chair and sit again leaning their back against the backrest. The time for performing the task was measured by a stopwatch device. Cutoff scores of 10 seconds or less for the complete test indicate normal mobility performance for independent non-faller subjects, between 11 and 20 seconds are within normal limits for frail elderly subjects with partial independence and low risk of falls, and scores greater than 20 seconds indicate a significant deficit of physical mobility and risk of falls[9].

The Box of Blocks test assessed the manual dexterity through evaluating the time of reaction, movement and speed of performance. The test was carried out at a well-lighted place counting on a chair, adequate for the size of the elderly, and a box positioned lengthwise, right in front of the participant. Then, the subject was oriented to move the blocks, one by one, from one compartment to the other, for 1 minute, beginning with the dominant hand and then with the non-dominant hand. The result was evaluated by the number of blocks the participant could move in 1 minute[10].

ii. Assessment of motor performance, muscle strength and flexibility by using the Berg Scale, and Functional Reach Test when standing and sitting.

The Berg Balance Scale (BBS) was applied to assess the participants' balance level and risk of falls. In accordance with the BBS orientations, 14 tasks were carried out and evaluated from 0 to 4, with 0 representing incapability and 4 full capability to execute the task. The tasks were: 1) Sitting to standing; 2) Standing unsupported; 3) Sitting unsupported; 4) Standing to sitting; 5) Transfers; 6) Standing with eyes closed; 7) Standing with feet together; 8) Reaching forward with outstretched arms; 9) Retrieving object from floor; 10) Turn to look behind; 11) Turning 360 degrees; 12) Placing alternate foot on stool; 13) Standing with one foot in front; 14) Standing on one foot[11].

The total score of BBS is 56 points, with 56 to 41 representing low risk of falls, from 40 to 21 showing an average risk of falls, and scores from 20 to 0 indicating a high risk of falls[11].

The Anterior Functional Reach Test (FRT) was carried out using a measuring tape mounted on the wall and parallel to the floor, at the height of the acromion of the subject. The participant was asked to stand keeping feet parallel to each other, perpendicular

to the wall and close to the starting point of the measuring tape. Keeping hand in neutral and fist position, outstretched elbows and shoulders forward flex to 90º, the elderly was oriented to reach as far forward as possible without touching the measuring tape and, the distance between the starting position and the end position was recorded. The result of the test was represented by the average of three trials, obtained by the difference between the performance measurements. Scores lower than 15 centimeters indicate limited functional balance and risk of falls. Scores from 16 to 25 cm show low risk of falls, while 25 cm or more indicate no risk of falls[9].

The Modified Functional Reach test, that follows the FRT concept, however the subject now is sitting on a non-backrest seat, high enough so feet are positioned flat on the floor, shoulders positioned at 90º and elbow outstretched. The subjects are oriented to be leaning forward as far as possible without touching the wall or moving from the seat[12].

Based on the initial evaluation, the participants were submitted to a group intervention protocol, carried out 2 times per week, on Tuesdays and Thursdays, from 8 to 11 hours, for 10 weeks.

The intervention was divided in three phases: a 15-minute preparatory phase; an active phase of 2 hours subdivided respectively in functional circuit (50 minutes), pause (10 minutes), walking (20 minutes), pause (10 minutes) and therapeutic exercises (30 minutes) and; a 10-minute slowdown phase.

The preparatory phase counted on stretching exercises for head, upper limbs (UL) and lower limbs (LL) during 30 seconds each movement; exercises for upper limb joint mobility and flexibility through the use of therapeutic plan and respiratory exercises associated to UL flexion, all with 3 series of 10 repetitions.

The active phase started with a functional circuit of task stations based on balance, functional reach, global and fine motor coordination and, cognitive dual tasks performance, each station for 3 minutes. After performing this phase, the participants were oriented to sit down, hydrate themselves and have a morning snack as recommended by the local nutritionist.

The elderly would then go out for a walk with the local caregivers, consisting of two routes. One of them considered a short route and recommended to dependent elderly and, a long one for more independent subjects. After returning from the routes they were instructed to hydrate themselves and physiologic variables were collected as means of controlling their general condition.

After this phase, therapeutic exercises for mobility of the trunk and UL were carried out using sticks with 3 series of 10 repetitions, UL and LL muscle strength focused on improving muscular power (low load, few repetition and quick speed)13 using resistant elastic band, shin guards weigh from 1 to 2 kg, sets of balls, rhythmic exercises and body expression through some dance performances.

The slowdown phase with muscle relaxation exercises using balls followed the myofascial release technique of arms, legs, buttocks, backbone and feet, facial expression exercises, facial self-massage and respiratory exercises in 3 series of 10 repetitions.

Data Analysis

A descriptive analysis was used for characterizing the sample. The softwares SPSS (Statistical Package for the Social Sciences) V20, Minitab 16 and Excel Office 2010 were used for the statistical analysis. The normality for the quantitative primary outcome variables was tested by Kolmogorov-Smirnov (KS) and the parametric statistical tests were defined. Paired Student T-test was used for testing and comparing the pre and post moments for all variables, and Person's correlation coefficient for the correlation analysis of the variables. A Confidence Interval (CI) for the average of 95% and the significance level adopted was of $p<0.05$.

Results

The Adult Day Care Center where the study was carried out assists 24 elderly subjects. This study included only 11 elderly participants since 13 did not meet the criteria for inclusion.

Therefore, the results of this study refer to 11 elderly female subjects, with an average age of 88 (± 4); incomplete Elementary School level; with a weekly frequency at the Adult Day Care Center OF an average of 4 (± 1) times per week and 12 (± 5) as MMSE average score indicating moderate cognitive impairment. The participants were submitted to a total of 28 intervention sessions.

All the participants, besides showing cognitive deficits, were diagnosed with at least 2 health alterations as arterial hypertension, diabetes, joint limitation or schizophrenia. In addition, 81% of the sample had health insurance plan coverage. The anthropometric characteristics constituting the nutritional evaluation are presented in table 1.

Table 1. Anthropometric Characteristics of the total sample (n=11)

	Means/ Standard Deviation
Weight (kg)	53 ± 9
Height	1 ± 0
BMI (Kg/m²)	24 ± 4
Arm circumference (cm)	26 ± 3
Triceps circumference (mm)	16 ±4
Abdomen circumference (cm)	90 ± 8
Waist circumference (cm)	77 ± 14
Hip circumference (cm)	96 ± 7
Calf circumference (cm)	32 ± 4

The Paired Student T-test was used to verify the difference between all variables in pre and post moments, as presented in table 2.

Table 2. Comparison of the results obtained in all tests during pre and post intervention (n=11)

Moments		Mean	Median	Stddv	Min	Max	N	CI	P-value
Seated Reach	Pre	22.3	20	10.4	10	47	11	6.2	0.003*
	Post	28.2	26	9.0	16	48	11	5.3	
Standing Reach	Pre	15.9	14	8.4	5	31	11	5.0	0.075
	Post	18.2	17	7.7	9	32	11	4.6	
Berg	Pre	45.2	49	9.2	21	53	11	5.4	0.274
	Post	42.3	45	12.4	14	53	11	7.4	
Box of blocks (Right Hand)	Pre	56.7	60	13.2	35	78	11	7.8	0.425
	Post	54.5	60	17.8	22	80	11	10.5	
Box of blocks (Left Hand)	Pre	52.8	54	10.2	34	64	11	6.0	0.347
	Post	50.3	51	16.6	20	73	11	9.8	
TUG	Pre	16.9	15	5.8	10	27	11	3.4	0.009*
	Post	12.5	12	3.9	8	23	11	2.3	

TUG (Timed up and Go); CI (Confidence Interval); * statistically significant values

Person's Correlation was used to verify the correlation of the tests indicating statistically significant correlations as shown in table 3.

Table 3. Average Correlation Coefficients found in the Post test (n=11)

Post		Seated Reach	Standing Reach	Berg	Box of blocks (Right Hand)	Box of blocks (Left Hand)
Standing Reach	Corr (r)	47.1%				
	P-value	0.143				
Berg	Corr (r)	44.6%	31.5%			
	P-value	0.169	0.345			
Box of blocks (Right Hand)	Corr (r)	39.8%	36.2%	86.1%		
	P-value	0.225	0.274	0.001*		
Box of blocks (Left hand)	Corr (r)	46.4%	36.1%	80.8%	96.4%	
	P-value	0.151	0.276	0.003*	<0.001*	
TUG	Corr (r)	-53.2%	-47.5%	-68.4%	-79.8%	-80.2%
	P-value	0.092	0.140	0.020*	0.003*	0.003*

TUG (Timed up and Go); * statistically significant values

Discussion

The results obtained in this study show changes in all the evaluated variables confirming the proposed physiotherapy exercises protocol to be effective for the functional health of elderly subjects in what concerns psychomotor functions and performance.

The prevalence of female elderly participants in this study meet the data of the World Health Organization (WHO) and the Alzheimer's Disease International (ADI). These organizations report that elderly women show higher probability to develop dementia. Such fact may be explained by the higher life expectancy in subjects of this group and for more frequently seeking for medical assistance if compared to male subjects, a contribution to the early diagnosis of diseases[14,15].

Likewise, a prevalence of long-lived elderly women who show moderate cognitive impairment was observed by the MMSE. Several studies have reported that the cognitive impairment is more consistent and homogeneous in the aging process and most frequently affecting women[16]. However, the worsening of functional functions varies greatly and each subject may show different progression but, in general, the functional performance is significantly related to the stage of dementia[17].

The outcomes of this study showed changes in all the evaluated variables (time of activity performance or total test score), both for psychomotor function and for motor performance, although not showing statistical significance. For example, in the Box of Blocks Test that evaluates manual dexterity, a reduction of the average time of performance for right and left hands was perceived, likewise it was observed in the standing reach test. Except for the static and dynamic balance test, assessed by the Berg Scale, where the score was lower at the post intervention assessment, as shown in table 2.

The attentional simplicity for executing the requested task for the box of blocks and functional reach tests might have influenced the results, considering the dementia stage of the participants. The command for both tests was simple and requested only one movement to assess psychomotor functions. On the other hand, the 14 tasks proposed for the Berg test demanded motor performance related to cognitive demands as coordination skills, static and dynamic balance and concentration, factors that could have influenced the results. Moreover, the protocol of exercises was proposed taking into consideration the age, health conditions, level of independence and fall prevention of the subjects. Toward that, it focused on stimulating their independence for everyday activities as short-distance walks, feeding and self-care skills. This is based on the results of the Seated and Standing Functional Reach test that also assesses the motor control of trunk and upper limbs (balance and mobility).

Previous studies have confirmed that the functional reach test shows significant improvements of resistance, balance, coordination and stretching performances in the post training results[18]. Moreover, physical activity practices when performed weekly in 2

sessions have proved successful for the improvement and/maintenance of flexibility. It is important to emphasize that this test can also assess the risk of falls, not only the flexibility levels[19].

Similarly, the TUG test showed significant results for mobility and reduction of risk of falls. The outcomes of this study are based on the review study of physical exercises plans for elderly AD-diagnosed subjects with preserved cognitive functions, showing improvements of flexibility, balance and not increasing fall risks[4]. The ability to concentrate, to keep short-term memory and to perform executive processes, as the planning of logically structured sequential actions and the capability to self-correcting actions are instrumental cognitive functions for daily life. Being able to carry out activities with multi-sensorial stimuli ends up improving skills, mainly in what refers to functional mobility[13].

Although the results of Berg test obtained in this study were not satisfactory, the correlation analysis when comparing the Berg and the TUG results showed a negative correlation, classified as a good result. Therefore, the variables are inversely proportional, that is, the higher the Berg score, the lower the value of TUG in seconds. This result consolidates the efficiency of the proposed protocol. The difference found in the TUG's result can be explained once the test requires the displacement of the body with postural changes, directly related to the mobility focused by the protocol of exercises. The Berg scale tests were not broadly executed in the protocol, as for example, the dynamic balance that depends on the integration of vestibular sense, responsible to send information of the body movement in relation to the gravity to the Central Nervous System, and the peripheral, vision, neuromuscular responses as muscle strength and reaction time[20]. Furthermore, the participants, although diagnosed with moderate AD, presented independent or semi-independent skills for daily activities and locomotion[21].

Another relevant outcome of this study refers to the correlations shown in table 3. The correlation between Berg and Box of blocks (Right Hand) results was positive indicating that the higher the Berg value is, the higher the value for Box of blocks (Right Hand), being therefore directly proportional. However, for the results of the Box of blocks (Right Hand) and TUG tests, the correlation was classified as negative, that is, inversely proportional, indicating that the higher the value of the Box of blocks is (Right Hand), the lower the TUG value. Nevertheless, the two conditions were classified as perfect correlations.

Although the dominant hand of the participants was the right hand, the same condition was found for the correlation of the Box of Blocks (left hand) for Berg and TUG results.

There is a correlation between the hand strength, balance and gait speed of elderly; the stronger the subject's hand is the best will be the dynamic balance and the fastest will be the gait speed. This fact occurs for the correlation existing between the values measured by the hand gripping strength with the muscle strength of upper and lower limbs. It is necessary to apply enough hand gripping strength to execute the Box of Blocks test with dexterity[22].

The results of this study showed that the proposed protocol was able to modify the psychomotor function and mobility of the elderly women with AD. Although with satisfactory results, it is important to emphasize some difficulties faced to execute the protocol. Due to the cognitive impairment of the participants, some of the proposed exercises were executed with difficulties, mainly those depending on the comprehension of the proposed task and/or physical limitation derived from the cognitive impairment that would not allow them to repeat the movement. As for example, difficulty paying attention; of judgement; reasoning; speech; memory and imagination[7].

The experience of group-based exercises shows a positive change through the reflection and stimuli resulting from the dialogues and observation[23]. The participants observed that the Physiotherapy applied in the group exercises brought benefits for their limited conditions, not only turning easier to execute the movements during the exercises but also promoting interaction among them, therefore improving socialization[24].

Another limitation of this study refers to the difficulty to produce the data generalization, due to the lack of a control group, the reduced number of participants included and the lack of homogeneity in health conditions.

This study suggests that the results obtained are not irreversible, thus, after the study was completed, the local caregivers were oriented and some self-explanatory brochures were provided as supporting material containing the sequence of exercises proposed in the protocol to be carried out at least 2 times per week by the elderly subjects.

Conclusion

The protocol of physiotherapy exercises showed efficiency in the functional health of the elderly subjects diagnosed with AD. Mainly in what refers to their psychomotor function and motor performance of functional reach and mobility, contributing significantly to reduce the risk of falls and maintaining their functional capacity.

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Author contributions

Dias CQ participated in the conception, design, data collection, statistical analysis of the data collected in the study, the interpretation of results and the elaboration of this scientific article. Barros JAS participated in the interpretation of results and the elaboration of this scientific article. Graciani, Z participated in the design and the data collection of this study. Amato CAH participated in the interpretation of results and the elaboration of this scientific article. Rodrigues E participated in the conception, design and the interpretation of results. Vianna DL participated in the statistical analysis of data and the interpretation of results. Fernandes SMS participated in the conception, design, statistical analysis of data collected in the study, the interpretation of results and the elaboration of this scientific article.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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