

Why Not a Global Postural Reeducation as an Alternative Therapy Applied to Alzheimer's Patients in Nursing Homes? A Pioneer Randomized Controlled Trial

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Keywords

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Abstract

Introduction: The classical gymnastics has always given great importance to exercises of rachis extension and abduction of the arms during deep inhalation to acquire a greater thoracic capacity. **Objective:** The aim of this study is to organize the concentration and the self-limited capacity of patients with Alzheimer's disease (AD) thanks to the physical and respiratory exercise modalities of global postural reeducation. **Design:** A randomized controlled trial was conducted. **Setting:** Nursing homes. **Participants:** Patients with probable AD diagnosis. **Intervention:** The global postural reeducation method (GPR) was implemented for a total of 72 treatment sessions with a frequency of 3 times a week, for 24 weeks consecutively. **Main Outcome Measures:** The Neuropsychiatric Inventory, Mini Mental State Examination, Geriatric Depression Scale, Quality of Life in Alzheimer's Disease and Tinetti Scale and respiratory rate frequency (RSP/F) were applied. **Results:** Ninety elderly people participated in this study, precisely 50 women and 40 men aged 67–92 years (mean age = 81.17, SD = 5.24). The therapy had a significant effect on the difference between groups in all the outcomes ($p < 0.05$ in all cases) with a large effect size with exception of the RSP/F ($p > 0.05$). **Conclusion:** This study demonstrated a very good tolerance rate on behalf of the significant results achieved.

1

Introduction

According to the Alzheimer's Association forecasted estimations, by 2025 the number of people aged 65 and over with Alzheimer's Disease (AD) will reach about 7.1 million [1]. In the study of Wetzels et al. [2] it was observed that this dramatic perspective can only be supervised with new curative treatments or prevention. The practice of physical exercise can positively influence cardiovascular, hormonal, neurological and respiratory levels [3, 4]. Stimulating physical activity thus seems to improve brain vitality and may be an appealing intervention to slow down dementia-related decline [3]. For example, classical gymnastics has always given great importance to exercises of rachis extension and abduction of the arms during deep inhalation to acquire a greater thoracic capacity [5]. According to the advocates of the postural methods these exercises are lordosizing, they go to the detriment of the body morphology both for their action on the rachis as well as for the one on the diaphragm that continuously stresses in inspiration [5]. Therefore, unlike traditional gymnastics, postural gymnastics trains the participant to concentrate on the sensations that come from his body during a movement or during assumption of a posture [6]. Taking into account that the aspiratory diaphragmatic block causes the shortening of the diaphragm, accentuates the lumbar lordosis and hinders paravertebral muscle lengthening, postural gymnastics aims to propose delordosis exercises and release diaphragmatic motion through a slow and deep exhalation [7]. In this respect global postural reeducation (GPR) therapy has been developed which manually interferes in the symptoms of mechanical origin. It is defined as a causal therapy, because, in its actions, it tries to interpret and modify the biomechanical alterations responsible for these symptoms and does not use analgesic agents to avoid symptom persistence [8]. The active muscle lengthening of this therapy extends the antigravity muscles (internal rotators and respirators) and is based on the understanding of postural muscle groups. For this reason, GPR considers breathing as fundamental. As observed any alteration in the body or mind immediately causes an alteration of the breathing; vice versa, breathing also influences the shape and functioning of the body as well as individuals' emotional and mental aspects. Therefore it is important to breathe well, without blockages or tensions that can negatively affect the rest of an individual's functions [9]. Although its benefits have been demonstrated in clinical practice, scientific evidence is crucial for its validation as a therapeutic alternative [10, 11]. In general, the alterations in respiratory mechanics derive from an excessive shortening of the respiratory muscles. Meanwhile the main causes of this shortening are psychological factors (stress), the increase in the volume of the visceral mass, inappropriate posture, respiratory disease, muscle weakness and aging [12]. All postural exercises involved in the GPR method allow respiratory muscle lengthening. Correspondingly, the aim of this study is to organize the concentration and the self-limited capacity of the patient with AD thanks to the physical and respiratory exercise modalities of GPR.

Methods

Study Design and Participants

This study was a cluster randomized controlled trial. Informed consent was obtained from each participant or his family.

Participants were recruited from five nursing homes of Tirana (Albania) and Malaga (Spain) (Fig. 1) according to the criteria of NINCDS-ADRDA [13] based on the medical documentation of dementia with probable diagnosis of AD. Patients older than 60 years, with depression, borderline and neurological symptoms, aggression, agitation, stroke, tumors and neuromuscular disease were excluded.

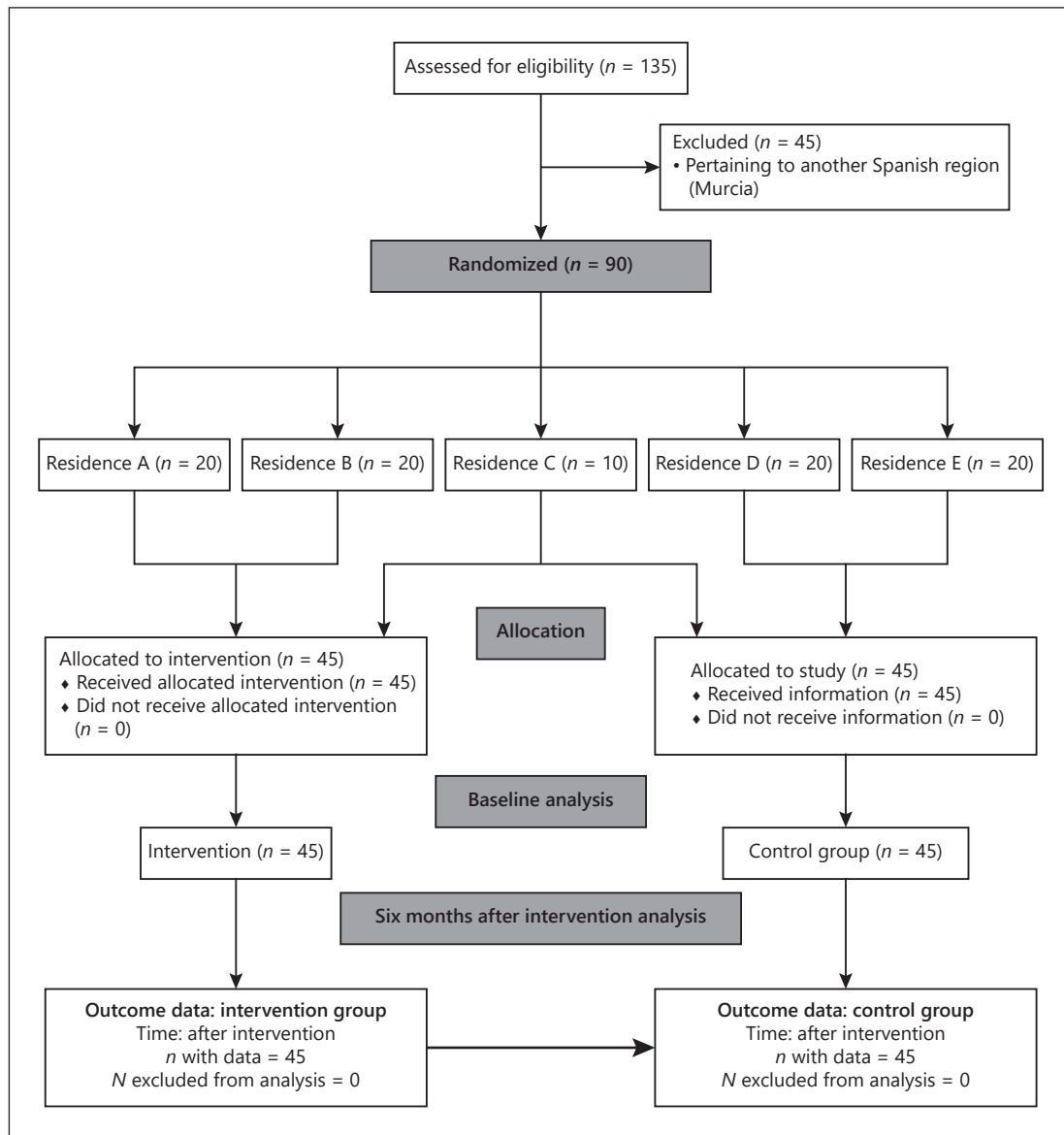


Fig. 1. Flowchart of participants.

The study sample size was determined as $n = 45$ per group based on the 0.6 effect size (the two-tailed type 1 error 0.05; type 2 error 80%). A caregiver who was not involved in the outcome assessment performed the randomization using a computer-generated 1:1 allocation system and permuted block size of 2. Participants were randomly assigned to the intervention group or the control group by this independent person. The sequence was concealed until intervention. This study did not blind physical therapists as to which patients were in the intervention group or control group.

All assessments were performed at the baseline and after 24 weeks.

The following questionnaires were used: Mini Mental State Examination (MMSE) for the cognitive evaluation [14], Quality of Life in Alzheimer's Disease (QoL-AD) [15] for patients (P) and caregivers (C), Geriatric Depression Scale (GDS) [16], Neuropsychiatric Inventory (NPI) [17] for neuropsychological symptoms, Tinetti subscale (TS) [18] for equilibrium and respiratory rate frequency (RSP/F) which consist in the time calculation of respiratory rate for every participant: 30 s of a person breathing, multiplying the number of breaths taken during that time by 2 [19]. Researchers who conducted the study and collected assessment data were blinded to group assignment.

Table 1. Baseline characteristics of participants

	GPR (<i>n</i> = 45)	CG (<i>n</i> = 45)	Total (<i>n</i> = 90)	<i>p</i> value
Characteristics				
Male	17 (37.8%)	23 (51.1%)	40 (44.4%)	>0.05
Female	28 (62.2%)	22 (48.9%)	50 (55.6%)	
Level of education				
Basic	10 (22.2%)	00 (00%)	10 (11.1%)	>0.05
Medium	27 (60%)	42 (93.3%)	69 (76.7%)	
High	08 (17.8%)	03 (6.7%)	11 (12.2%)	
Alzheimer phase				
Mild	22 (48.9%)	18 (40%)	40 (44.4%)	>0.05
Moderate	23 (51.1%)	27 (60%)	50 (55.6%)	
Mean age \pm SD, years	81.87 \pm 4.83	80.47 \pm 5.59	81.17 \pm 5.24	>0.05

GPR, intervention group; CG, control group; *n*, number of participants; SD, standard deviation; *p*, significance value.

Intervention

The participants in the GPR group individually underwent three weekly 40-min sessions of GPR by 5 certified physiotherapists with a minimum of 3 years' experience in this technique. In total 72 sessions of GPR were implemented during a 24-week period of the study. Only 3 of 6 GPR postures described by Souchart et al. [12] were used in a standardized fashion. Each stretching posture lasted about 10 min. The intervention consisted in a global neck pumpage, the patient lying relaxed associated with deep diaphragmatic breathing in all cases and the supine frog position for the first 2 months. During the second period of intervention; i.e., in the third and fourth months, the position "lying on back with the legs extended" was performed with arms open and associated with deep diaphragmatic breathing. In the fifth and sixth months "sitting with legs extended" was used, associated with deep diaphragmatic breathing. The diaphragmatic breathing techniques were measured in combination with the neck pumpage, as for every 3 min of GPR treatment the neck pumpage lasted 90 s, and at the same time the participant was asked to breathe deeply. The participants of the control group remained with the nursing home activities such as: 20 min of walking per day, group aerobic activities, occupational therapies and art therapies. These activities were similar in all five study nursing homes selected. All study participants were followed up in person.

Statistical Procedure

The statistical analysis was carried out by using a mixed factorial ANOVA procedure. To compare the mean change of the outcomes after 24 weeks of intervention compared to the baseline between the experimental and control group, the analysis of covariance (ANCOVA) was employed. The independent samples *t* test was performed to assess the homogeneity of groups for clinical characteristics of the patients. For effect size measure, partial ϵ^2 was calculated for the ANCOVA model, and it was considered small at 0.01, medium at 0.09 and large at 0.25. The value of the significance was corrected according to the Bonferroni approach for multiple comparisons (95% confidence level, $p < 0.05$ value). The statistical program SPSS 20 (SPSS Inc., Chicago, IL, USA) for Windows was used.

Results

Ninety elderly people participated in the research study mentioned above, precisely 50 women and 40 men aged 67–92 years (mean age = 81.17, SD = 5.24), and were divided into two groups based on the intervention action (Fig. 1). The baseline participant characteristics are summarized in Table 1.

For baseline and 24 weeks after treatment, change scores and effect sizes for the clinical outcomes after the implementation of GPR treatment are described in Table 2.

Table 2. Between/within-group difference at baseline and after 24 weeks of treatment

Outcomes in points	Sample	N	Baseline (T0)				24 weeks (T1)					
			mean \pm SD	mean difference (95% CI)	p	t	Cohen's d	mean \pm SD	mean difference (95% CI)	p	t	Cohen's d
QoL-AD/C (0-52)	GPR	45	33.44 \pm 4.95	0.70 (-2.03, 3.04)	0.599	0.528	0.11	35.13 \pm 6.2	4.70 (1.92, 7.49)	0.001	3.363	0.7
	CG	45	32.71 \pm 7.89					30.42 \pm 7.05				
QoL-AD/P (0-52)	GPR	45	33.64 \pm 5.15	-0.62 (-3.03, 1.79)	0.610	-0.512	0.10	35.22 \pm 5.53	3.08 (0.66, 5.51)	0.013	2.532	0.53
	CG	45	34.27 \pm 6.30					32.13 \pm 6.02				
MMSE (0-30)	GPR	45	21.58 \pm 2.75	2.08 (0.66, 3.51)	0.005	2.916	0.61	22.13 \pm 2.51	4.35 (3.88, 5.62)	0.000	6.797	1.43
	CG	45	19.49 \pm 3.93					17.78 \pm 3.49				
GDS (0-15)	GPR	45	5.67 \pm 2.05	-2.73 (-3.86, -1.60)	0.000	-4.797	1.01	4.56 \pm 2.19	-4.64 (-5.60, -3.68)	0.000	-9.57	2.01
	CG	45	8.40 \pm 3.22					9.20 \pm 2.40				
NPI (0-120)	GPR	45	19.00 \pm 4.32	1.62 (-0.64, 3.89)	0.159	1.420	0.29	15.33 \pm 3.87	-6.17 (-8.38, -3.96)	0.000	-5.552	1.17
	CG	45	17.38 \pm 6.32					21.51 \pm 6.37				
TS (0-13)	GPR	45	11.27 \pm 1.52	3.31 (2.21, 4.40)	0.000	6.011	1.26	12.04 \pm 1.50	4.53 (3.45, 5.61)	0.000	8.339	1.75
	CG	45	7.96 \pm 3.36					7.51 \pm 3.32				
RSP/F (0-30)	GPR	45	13.33 \pm 2.27	-0.40 (-1.30, 0.50)	0.381	-0.880	0.18	15.13 \pm 1.45	-0.22 (-0.79, 0.34)	0.441	-0.773	0.16
	CG	45	13.73 \pm 2.02					15.36 \pm 1.26				
T1-T0/within-group difference												
ANOVA												
mean difference (95% CI)			F	p	η^2	T1-T0/between-group difference		T1-T0 effect size		ANOVA		
						mean difference (95% CI)	Cohen's d	F	p	η^2		
2.72 (0.004 to 5.44)			3.96	0.050	0.043	4.02 (2.94, 5.11)	0.59	54.77	0.000	0.386		
1.23 (-1.13 to 3.59)			1.07	0.303	0.012	3.65 (2.65, 4.66)	0.43	52.72	0.000	0.377		
3.22 (1.90 to 4.54)			23.61	0.000	0.212	2.65 (2.09, 3.21)	0.82	89.42	0.000	0.507		
-3.68 (-4.68 to -2.68)			53.76	0.000	0.379	-2.74 (-3.36, -2.11)	1.00	75.45	0.000	0.464		
-2.27 (-4.46 to -0.09)			4.29	0.041	0.047	-7.60 (-8.57, -6.62)	0.88	240.03	0.000	0.734		
3.92 (2.84 to 4.99)			52.36	0.000	0.373	1.38 (1.03, 1.74)	0.49	61.71	0.000	0.415		
-0.31 (-0.98 to 0.36)			0.83	0.364	0.009	-0.05 (-0.47, 0.37)	-0.02	0.050	0.810	0.001		

GPR, intervention group; CG, control group; n, number of participants; SD, standard deviation; CI, confidence interval; p, significance value; t, Student t test; d, effect size; QoL-AD/C, Quality of Life in Alzheimer's Disease/Caregivers; QoL-AD/P, Quality of Life in Alzheimer's Disease/Participants; MMSE, Mini Mental State Examination; GDS, Geriatric Depression Scale; NPI, Neuropsychiatric Inventory; TS, Tinetti Scale; RSP/F, respiratory rate frequency. T1-T0, 24 weeks minus baseline; ANCOVA, analysis of covariance with baseline data as covariate; η^2 , eta squared effect size.

No significant differences between groups were found in QoL-AD/C, QoL-AD/P, NPI and RSP/F outcomes ($p > 0.05$) at the baseline. Referring to the MMSE, GDS and TS outcomes, significant differences between groups were shown ($p < 0.05$) at the baseline (Table 2).

By observing the GPR and the control groups in the 24 weeks of treatment, the t test shows a significant difference between groups as per: QoL-AD/C [$t(88) = 3.36, p = 0.001$], QoL-AD/P [$t(88) = 2.53, p = 0.013$], MMSE [$t(88) = 6.79, p = 0.000$], GDS [$t(88) = -9.57, p = 0.000$], NPI [$t(88) = -5.55, p = 0.000$], TS [$t(88) = 8.33, p = 0.000$] with a large effect size ($d > 0.25$ in all cases) with the exception of the RSP/F [$t(88) = -0.77, p = 0.44$] where no difference between groups was demonstrated.

The analysis of differences within groups shows that the outcomes such as MMSE [$F_{1,88} = 23.61, p = 0.000, \eta^2 p = 0.212$], GDS [$F_{1,88} = 53.76, p = 0.000, \eta^2 p = 0.379$], NPI [$F_{1,88} = 4.29, p = 0.041, \eta^2 p = 0.047$] and TS [$F_{1,88} = 52.36, p = 0.000, \eta^2 p = 0.373$] were significant in the 24 weeks of GPR treatment. Concerning the QoL-AD/C, QoL-AD/P and RSP/F, no significant differences within groups were found ($p > 0.05$).

The analysis of ANCOVA demonstrated a significant difference between groups for all the outcomes as per: QoL-AD/C [$F_{1,87} = 54.77, p = 0.000, \eta^2 p = 0.386$], QoL-AD/P [$F_{1,87} = 52.72, p = 0.000, \eta^2 p = 0.377$], MMSE [$F_{1,87} = 89.42, p = 0.000, \eta^2 p = 0.507$], GDS [$F_{1,87} = 75.45, p = 0.000, \eta^2 p = 0.464$], NPI [$F_{1,87} = 240.03, p = 0.000, \eta^2 p = 0.734$] and TS [$F_{1,87} = 61.71, p = 0.000, \eta^2 p = 0.415$] with a large effect size in 24 weeks of treatment. No significant differences between groups were shown for RSP/F outcome during the 24 weeks of intervention ($p > 0.05$).

Discussion

This study is part of a previous pilot randomized controlled trial [20], and the analyzed results relate to the different locations of participants. In total 5 nursing residences in Tirana (Albania) and Malaga (Spain) were analyzed (Fig. 1). In this study we observed whether an equal group of participants and a different cultural location influenced the results. This study tries to verify whether even the respiratory rate frequency influences the results. The efficacy of the GPR method for a 24-week period was evaluated, with a frequency of 3 times a week, in patients with AD. There was an improvement in all the variables analyzed (cognition, mood, behavioral disorders, balance and quality of life). Observing the RSP/F results for 24 weeks of treatment, no significant improvement between groups was demonstrated. The QoL-AD/C and QoL-AD/P assessments were separately analyzed with the aim to verify whether there is accordance or difference in what patients and caregivers reported for the same test [20]. In accordance with these results, in a recent systematic review of people with mild cognitive impairment, the overall results indicated a significantly improved global cognitive function following the mind-body exercise, a type of multimodal exercise characterized by slow physical movements, full-body stretching and relaxation, breathing technique and mental concentration [21]. It can be said that the GPR method has some advantages in relation to other types of stretching due to the fact that it maintains the muscles in extension for a prolonged period. Not only that, but GPR activates the muscle groups in an integrated way, facilitating the adaptations that promote improvements in terms of flexibility and strength [20, 22]. These favorable results are also confirmed in other studies, which specify the effect of GPR on respiratory diseases [23, 24]. In many clinical studies it is important to place the patient in the postures of "frog on the floor with closed arms" and "frog in the air." According to the authors, both postures allow a better stability of the diaphragm insertion points, being ideal for working the pectoral muscles of the diaphragm, i.e. the sternocleidomastoid, scalenus, intercostal major and minor [12, 25]. The postures mentioned above have shown a statistically significant improvement in thoracic expansion and maximum respiratory pressure in two other studies [26, 27].

The study limits consist in identifying the residences where certified GPR therapists are available; initially this is closely related to the distances between the residences where the study took place, which further affects the completion of the questionnaires [11, 20]. However, this study demonstrated a very good tolerance rate on behalf of excellent results achieved through which were also provided useful data to develop other randomized controlled trials with GPR therapy. It can also be affirmed that perhaps only the fact of an individual treatment of AD patients positively affects the results. Nonetheless this pioneering study suggests that regardless of severity, postural therapy is a useful tool in treating patients with AD.

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Statement of Ethics

The study was approved by the Catholic University of Murcia Ethics Committee (approval No.: 6573), in full compliance with ethical standards of the Committee on Human Experimentation of the institution in which the experiments were done as well as with the ones of the Helsinki Declaration of 1975, and was registered in Clinicaltrials.gov (Identifier: *NCT03732053*).

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Author Contributions

J.T. designed and conducted the study, supervised the data collection, performed the data analysis, interpretation and writing of the manuscript. A.T. advised in designing and conducting the study, performed the data analysis and interpretation and critically revised the manuscript. O.L. conducted the study, contributed in interpretation of data and revised the manuscript. All authors have read and approved the final paper.

References

- 1 Alzheimer's Association. 2017 Alzheimer's disease facts and figures. *Alzheimers Dement*. 2017;13(4):325–73.
- 2 Wetzels RB, Zuidema SU, de Jonghe JF, Verhey FR, Koopmans RT. Determinants of quality of life in nursing home residents with dementia. *Dement Geriatr Cogn Disord*. 2010;29(3):189–97.
- 3 Henskens M, Nauta IM, van Eekeren MC, Scherder EJ. Effects of physical activity in nursing home residents with dementia: a randomized controlled trial. *Dement Geriatr Cogn Disord*. 2018;46(1-2):60–80.
- 4 Pettersson AF, Olsson E, Wahlund LO. Motor function in subjects with mild cognitive impairment and early Alzheimer's disease. *Dement Geriatr Cogn Disord*. 2005;19(5-6):299–304.
- 5 Pillastrini P, de Lima E Sá Resende F, Banchelli F, Burioli A, Di Ciaccio E, Guccione AA, et al. Effectiveness of global postural re-education in patients with chronic nonspecific neck pain: randomized controlled trial. *Phys Ther*. 2016 Sep;96(9):1408–16.
- 6 Troletti GG, Troletti D. *Ginnastica dolce. Percezione e consapevolezza del corpo*. Roma: Edizioni Mediterranee; 1999.

- 7 Maluf SA, Moreno BG, Crivello O, Cabral CM, Bortolotti G, Marques AP. Global postural reeducation and static stretching exercises in the treatment of myogenic temporomandibular disorders: a randomized study. *J Manipulative Physiol Ther*. 2010 Sep;33(7):500–7.
- 8 Cunha AC, Burke TN, França FJ, Marques AP. Effect of global posture reeducation and of static stretching on pain, range of motion, and quality of life in women with chronic neck pain: a randomized clinical trial. *Clinics (São Paulo)*. 2008 Dec;63(6):763–70.
- 9 Teodori RM, Negri JR, Cruz MC, Marques AP. Global Postural Re-education: a literature review. *Rev Bras Fisioter*. 2011 May-Jun;15(3):185–9.
- 10 Moreno MA, Catai AM, Teodori RM, Borges BL, Cesar MC, Silva E. [Effect of a muscle stretching program using the global postural reeducation method on respiratory muscle strength and thoracoabdominal mobility of sedentary young males]. *J Bras Pneumol*. 2007 Nov-Dec;33(6):679–86. Portuguese.
- 11 Todri J, Lena O, Gil JM. A single blind randomized controlled trial of global postural re-education: cognitive effects on Alzheimer disease patients. *Eur J Psychiatry*. 2018;33(2):83–90.
- 12 Souchard PE, Meli O, Sgamma D, Pillastrini P. Rieducazione posturale globale. *EMC Med Riabilitat*. 2009;26(3):061-A-15.
- 13 Tierney MC, Fisher RH, Lewis AJ, Zorzitto ML, Snow WG, Reid DW, et al. The NINCDS-ADRDA Work Group criteria for the clinical diagnosis of probable Alzheimer's disease: a clinicopathologic study of 57 cases. *Neurology*. 1988 Mar;38(3):359–64.
- 14 Arevalo-Rodriguez I, Smailagic N, Roqué i Figuls M, Ciapponi A, Sanchez-Perez E, Giannakou A, et al. Mini-Mental State Examination (MMSE) for the detection of Alzheimer's disease and other dementias in people with mild cognitive impairment (MCI). *BJPsych Adv*. 2015;21(6):362.
- 15 Logsdon RG, Gibbons LE, McCurry SM, Teri L. Assessing quality of life in older adults with cognitive impairment. *Psychosom Med*. 2002 May-Jun;64(3):510–9.
- 16 Yesavage JA, Brink TL, Rose T. Geriatric depression scale (GDS). Handbook of psychiatric measures. Washington (DC): American Psychiatric Association; 2000. pp. 544–6.
- 17 Cummings JL, Mega M, Gray K, Rosenberg-Thompson S, Carusi DA, Gornbein J. The Neuropsychiatric Inventory: comprehensive assessment of psychopathology in dementia. *Neurology*. 1994 Dec;44(12):2308–14.
- 18 Tinetti ME. Performance-oriented assessment of mobility problems in elderly patients. *J Am Geriatr Soc*. 1986 Feb;34(2):119–26.
- 19 Kennedy MC. A practical measure of the maximum ventilatory capacity in health and disease. *Thorax*. 1953 Mar;8(1):73–83.
- 20 Todri J, Lena O, Martínez Gil JL. An experimental pilot study of global postural reeducation concerning the cognitive approach of patients with Alzheimer's disease. *Am J Alzheimers Dis Other Demen*. 2019 Aug; 1533317519867824. Epub.
- 21 Zou L, Loprinzi PD, Yeung AS, Zeng N, Huang T. The beneficial effects of mind-body exercises for people with mild cognitive impairment: A systematic review with meta-analysis. *Arch Phys Med Rehabil*. 2019 Aug; 100(8):1556–73.
- 22 Blankevoort CG, van Heuvelen MJ, Boersma F, Luning H, de Jong J, Scherder EJ. Review of effects of physical activity on strength, balance, mobility and ADL performance in elderly subjects with dementia. *Dement Geriatr Cogn Disord*. 2010;30(5):392–402.
- 23 Alves Guimarães É, Naves Alkmim D, Nascimento MC, de Matos Boaventura C, Sachi Magazoni V. Adaptações do sistema respiratório referentes à função pulmonar em resposta a um programa de tratamento muscular pelo método de Reeducação Postural Global. *ConScientiae Saúde*. 2013;12(1):97–105.
- 24 Lozano RA, Nogueira FR, Reis L, Machado EC, Veiga J. Efeitos da reeducação postural global na PIMAX, mobilidade torácica e qualidade de vida de pacientes portadores de doença pulmonar obstrutiva crônica. *Novo Enfoque*. 2010;10:101–12.
- 25 Contesini AM, Garcia JA, Caromano FA. Influência das variações da postura sentada na função respiratória: revisão de literatura. *Fisioter Mov*. 2017;24(4):757–67.
- 26 Yap JC, Moore DM, Cleland JG, Pride NB. Effect of supine posture on respiratory mechanics in chronic left ventricular failure. *Am J Respir Crit Care Med*. 2000 Oct;162(4 Pt 1):1285–91.
- 27 Walsh JH, Maddison KJ, Platt PR, Hillman DR, Eastwood PR. Influence of head extension, flexion, and rotation on collapsibility of the passive upper airway. *Sleep*. 2008 Oct;31(10):1440–7.