



Effects of Hatha-Yoga Program on a Small Group with Alzheimer's Disease

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Abstract

The main interest of this research, was to determine the effect of a Hatha Yoga program on psychological (quality of life, anxiety, depression, working memory and processing speed), physical (balance and flexibility) and functional (basic and instrumental activities) variables in a group of patients with Alzheimer's Disease in Bogota, Colombia. Eight adults diagnosed with Moderate Alzheimer Dementia by an interdisciplinary health team from the Fundación Cardio Infantil (Hospital in Bogota), and with score of five in the Global Deterioration Scale (GDS), participated in this study. Descriptive statistics was used to make comparisons in measurements taken before and after the Hatha Yoga program and inferential statistics were used to test hypotheses. Improvements in balance and elasticity were revealed by Wilcoxon test.

Keywords: Physical Exercise; Yoga; Dementia

Background

Alzheimer disease (AD) has been considered as "the Century's disease". According to the World Health Organization (WHO), there are 20 million people affected with AD all around the world. Moreover, it is estimated that this number can be trebled by 2040.

AD is a degenerative disease; it implies a progressive lost of nervous cells. At a neuropsychological level, it affects different cognitive processes as memory, language, praxis, gnosis and executive functions. Neurological testing, can report signs as frontal reflexes liberation, smell disorders, agraphesthesia, walking disorders, shaking, extrapyramidal signs, cerebellum disorders and convulsions [1]. Besides, emotional and behavioral symptoms – anxiety, acatysia, sleep disorders, delirium and depression- can be presented as well. It can be established that these symptoms make it more difficult to manage AD [2].

Functionality and quality of life are also affected in people with AD. The first one is the capacity to carry out those activities which are necessary for the bio-psycho-social well-being [3]. Basic functionality includes activities that are necessary for the achievement an independent life in community; advanced functionality deals with those activities which make it possible to develop a social role [4]. Quality of life is a multidimensional concept. It includes a physical component, a psychological component, a social component and a spiritual component [5].

AD involves an economical and emotional cost, for that reason, the understanding of aspects related with AD prevalence, risk factors and potential interventions, are topics of significant importance for medical attention and public health [6].

The purposes of the interventions are, the delaying of the degenerative process and keeping patients quality of life [7]. Nowadays, there are several pharmacological and non pharmacological treatments those are oriented to: slowing down the AD progression, to control neuropsychiatric symptoms; and, to improve quality of life of patients and the caregivers. Physical activity is one of the non pharmacological treatments, which increases strength, energy and ability to carry out daily life activities. Besides, it has a relaxing effect, and reduces muscular tension and anxiety caused by stress. Physical activity facilitates the

availability of cognitive resources and improves sleep. Therefore, it is not surprising, that physical activity favors quality of life [8].

Teri and Gibbons [9] trained patients with AD in set of exercises, and taught the caregivers behavioral techniques. After applying both exercises and techniques, it was found an improvement in physical health and a decreased in depression. Physical exercise practiced regularly can delay deterioration. It also moderates the cognitive functioning decrease caused by age [9]. Consequently, it gives a protective factor against AD [10,11]. Moreover, it had been established that neurotrophic factors could be favored by physical activity [12].

Hatha-Yoga is an exercise where physical movement -physical poses-, breathing exercises and relaxation techniques are combined. Hatha-Yoga is a kind of Yoga, which focuses on physical activity through positions, which include balance, equilibrium and inclinations. These poses are retained during a certain period of time. Hence, person's attention is focused on those muscles in which the individual is working on, as well as on his breathing [13]. These poses increase flexibility, and activate blood circulation along the body, particularly in glands and internal organs.

It has been found that the main effects of Hatha-Yoga are: reduction of stress and its symptomatology, as well as self-efficacy promotion [14]; improvement of quality of life in aspects such as: vitality, energy, physical fitness, body pain and social functioning and body composition [15]. More over there is evidence of a physiological activation decrease during yoga exercise, reduction of oxygen consumption without an increase of lactate levels in blood [16]; diminish of headaches and backaches [14]; flexibility improvement and breathing regulation [17]; autonomous balance change, improvement in breathing and in the systolic and diastolic pressure; and general well- being [18].

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Received April 19, 2011; Accepted August 06, 2011; Published August 08, 2011

Citation: Gallego Q, Alexey E, Ma Clara R, Lina G, Reyes A (2011) Effects of Hatha-Yoga Program on a Small Group with Alzheimer's Disease. J Yoga Phys Therapy 1:104. doi:10.4172/2157-7595.1000104

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The purpose of this research is to test if patients with AD achieve better scores in psychological, functional and physical variables after doing the Hatha-Yoga program, in comparison to the scores achieved before the program.

Method

Research type

Pre-experimental design with one group pre-test and post-test:

- **Participants:** The sample was constituted by eight volunteer patients diagnosed with AD (moderate dementia). They were seven women and a man over 60 years old.
- **Inclusion criteria were:** a) a score of 5 at the Global Deteriorate Scale, b) to be covered by the health system, c) having under control other medical condition, d) attend accompanied by their caregivers.
- **The exclusion criterion was:** a) to present disabling motor problems or acute decay diagnosis (delirium) for the last 6 months.

Besides the criteria referred previously, all the participants were assessed by the neuropsychologist of the team. Mini mental state examination score was between 15 and 19, procedural memory and imitation skills were preserved. At the same time, they were capable to follow simple and short instructions formed by two commands. These capacities let them to participate in Hatha Yoga program and guarantee their capacity to follow instructions adequately.

Instruments: The following instruments were used to measure each dependent variables:

1. **Quality of life in patients diagnosed with Alzheimer Disease (ADRQL).** It is a hetero - applied scale where the caregiver gives answers based on the patient behavior during the last two weeks previous the program.
2. **Hamilton scales for measuring anxiety and depression.** These scales test the symptomatic profile as well as the seriousness of the anxious and depressive manifestation during last days. These instruments are hetero - applied.
3. **Working memory and processing speed indexes.** The respective sub-tests -appropriate for the aged they were diagnosed with dementia - of the intelligence scale WAIS III of Wechsler were applied[19].
4. **Tinetti Scale.** This scale assess walking and equilibrium. A score of less than 10 in equilibrium items or less than 9 in walking items represents high risk of falling.
5. **Sit and Reach modified test.** It measures flexibility in centimeters.
6. **Barthel Scale.** It was published by Mahoney and Barthel in 1965. It is useful for testing daily life activities in patients who suffer neuro-muscular and muscle-skeletal disorders.
7. **Lawton and Brody Scale.** It is also known as Philadelphia Geriatric Center Instrumental Activities Daily Living (PGC-IADL). It is recommended for testing instrumental activities carried out by non institutionalized people. This Scale shows the capacity of functional autonomy.
8. **Qualitative questionnaire.** Used for the identification of the caregivers' perception about the program, the adherence

to it, and the perceived benefits in a physical, emotional and cognitive level. This questionnaire was designed by the research staff and validated by experts.

Procedure

Firstly, it was taken into account the database of patients diagnosed with AD at a health institution in Bogotá - Fundación Cardio Infantil (Bogotá, Colombia). Once they were contacted and informed about the research, they gave consent, which was signed by patients and caregivers. Consequently, the instruments were applied.

The Hatha- Yoga program was designed by a yoga instructor based on the particular conditions of the population. It was composed by seven asanas, which were guided with short and repetitive directions. These instructions were without an abstract concept or laterality reference. The program was applied during 14 weeks, 2 sessions per week with one hour duration each one. Each session contains warm up exercises, Hatha Yoga Asanas oriented to work on flexibility (for example, tweezers), balance (for example, tree), strength (for example, warrior), respiration (cat-dog posture and pranayama), cerebral oxygenation and venous return (for example, simple variant of the wing), and finally a relaxation stage.

The Yoga instructor frequently was emphasizing in breathing and selfawareness, repeating the instructions "attention and concentration", showing slowly each one of the seven exercises and making corrections and visual feedback. The Yoga instructor, a doctor, a researcher and three assistants participated during the sessions.

Measures of qualitative were taken, related to the process, home activities and changes reported by caregivers. At the end of the program, the same instruments were applied.

Results

Six of the participants attended the 100% of the sessions and 2 fulfilled the 70%. A descriptive analysis was carried out in order to examine the participants' performance in the tests. Moreover, the signs coefficient of Wilcoxon was used.

Table 1 shows the participants distribution according to the socio-demographic variables.

Table 2 shows the variables performance before and after the program.

Participants one, two and three preserved their scores in the work memory variable, the participants four, five and six, had a decrease in their scores and the last seven and eight improved their scores at the post-test. Regarding the processing speed, participants, two, three, four, six, seven and eight, maintained the same score for the pre-test and the post-test, whilst the participants on and five, obtained a superior score at the post-test.

Participant	Gender	Age	Academic level	Time of evolution (years)
1	Female	69	Elementary	1,5
2	Female	83	Elementary	2
3	Female	79	Secondary	2
4	Male	73	Secondary	4
5	Female	65	University	3
6	Female	76	Secondary	2
7	Female	70	Secondary	4
8	Female	83	University	3

Table 1: Participants of the Yoga Program.

In relation to the Anxiety Scale, it was found that participants one and five were placed in the mild anxiety range in both measurements, whilst participant eight obtained a moderate range. Participants two, three, six and seven went through a lower level to a higher level, whereas that, only participants four and five passed to a lower level. Concerning the Depression Scale, it was observed that all the participants maintained the same level of depression after the program; except from two participants (four and six) who change from a moderate depression symptomatology to absence of depression symptoms.

On the other hand, the results showed an improvement in the quality of life of four participants (one, four, six and seven). One participant (three) presented the same scores in both measures and three (two, five and eight), reported a decrease. With reference to the physical variable (flexibility and equilibrium), the results revealed an improvement in all participants, excepting participant eight.

Basic functionality was the same for participants one, four, six and seven. Three participants (two, three and five) a mild difference was observed, however the level of dependence remained equal; only one participant (8) had a negative change.

Similar results were revealed with regard instrumental functionality, participants two, three, four seven and eight, preserved the same scores, participants one and five. Participants one and five, remained in the semi-dependence level; and, participant six, went from moderate dependence to a semi-dependence level.

Table 3 shows the results achieved through the non parametric test Wilcoxon. Besides, significance levels achieved for each variable between pre- test and post- test measurements are illustrated. It can be observed that equilibrium and flexibility were the variables that presented a significant change.

On the other hand, it was carried out a qualitative analysis of the

caregivers' perception of the program, the adherence and its benefits. Changes at physical, cognitive and emotional level were found Table 4. In Table 4 is showed the caregivers' perception of patients' physical changes regarding with the ability to move from a side to side. The most perceived psychological and cognitive functioning changes were related to the concentration capacity, socialization and a decreased in their level of stress.

Discussion

The purpose of this research was to identify possible effects of a Hatha-Yoga program on physical, psychological and functionality in patients diagnosed with AD with a GDS of five. People with moderate dementia, where the neurodegenerative process is not very advanced, maintained certain cerebral neuroplasticity, that can be stimulated by non pharmacological therapeutic programs, similar to the one proposed in the present paper, which mainly affect environmental factors [20].

The work focused on moderate dementia patients involves a challenge. Although they are starting to lose their ability to conceptualize; and to show the four "a's": amnesia, aphasia, apraxia and agnosia; they still have specific operations that involve a direct relationship with objects. Therefore, they can achieve to understand tasks when the material is present. They also maintain relationships of order and closeness; and have well-preserved some cognitive functions [21,22]. The latter allows the proposition of programs characterized by a simple language, with clear and repetitive instructions, using imitation as a starting point. The residual capacities maintained by our group of patients allowed them to carry out exercises (postures) in repetitive and routinely way; this facilitated the maintenance of a number of cognitive abilities such as working and procedural memory.

It was found that three patients did not present changes related to

Variable	Measure	Subj 1	Subj 2	Subj 3	Subj 4	Subj 5	Subj 6	Subj 7	Subj 8
Working memory	Pretest	90	95	95	96	98	97	93	90
	Postest	90	95	95	95	93	96	96	95
Processing speed	Pretest	64	62	62	62	79	62	62	62
	Postest	62	62	62	62	74	62	62	62
Anxiety	Pretest	13	12	2	9	15	4	10	20
	Postest	7	20	6	5	10	8	16	28
Depression	Pretest	3	8	1	16	12	9	12	23
	Postest	7	12	6	7	18	7	18	21
Quality of life	Pretest	39	41	46	32	25	36	32	32
	Postest	38	38	44	33	17	43	35	16
Equilibrium	Pretest	26	25	16	25	15	21	15	N/A
	Postest	27	28	20	27	27	25	28	N/A
Flexibility	Pretest	24	15	11	11,5	14	11	14	5
	Postest	29	19	15	21	17	24	15	5
Basic functionality	Pretest	100	90	100	100	90	100	100	45
	Postest	100	85	90	100	100	100	100	20
Instrumental functionality	Pretest	6	4	4	3	2	4	3	1
	Postest	5	4	4	3	3	3	3	1

Table 2: Results achieved by each variable through measure and subject.

VARIABLES	WM	PS	EQ	FLEX	BF	IF	ANX	DEP	CDV
Significance	1.00	0.18	0.01*	0.02*	0.35	0.56	0.35	0.32	0.49

WM: working memory, PS: Processing speed, Eq: equilibrium, FLEX: flexibility, BF: Basic functionality, IF: Instrumental functionality, ANX: anxiety, DEP: depression and QOL: quality of life.* p < 0.05

Table 3: Sign Test and Wilcoxon Signed-Rank Test – Pre- posttest.

Dimension	Category	# of patients reporting changes
Physical	> Speed	2
	> Resistance	3
	> Strength	2
	> Equilibrium	2
	> Flexibility	3
	Movement improvement	6
	Walking improvement	3
Cognitive	Fluctuation	4
	> Mental agility	1
	> Concentration	5
	Improvement in following instructions	4
	Remembering exercises	1
Emotion	It is kept	3
	> Happiness	3
	> Quiet	2
	> Interaction (speaking, answering)	3
Adherence to the treatment (patient)	Preparation for the program	6
	Evoking specific events (breathing)	2
Benefits for the caregiver	Physical condition	3
	Stress decrease	5
	Interaction	1

Table 4: Caregivers report of perceived changes.

working memory. However, five caregivers observed working memory and attention improvement -Patients were more concentrated, participated in conversations and remembered it was important breathing properly-. So, maintaining these faculties could be the result of the repetitive practice of Yoga poses since research outcomes suggest higher levels of physical activity -compared to non activity- are related to an increase in circulation of brain blood. And, it is clear this can decrease the risk of cognitive damage [6].

The research has shown that the underlying neuroanatomical system responsible for procedural memory is independent of declarative memory; and, therefore, patients with Alzheimer's can acquire motor, perceptual and cognitive skills. Procedural learning and implicit memory, kept until last stages of AD [23], is an opportunity of learning a physical activity routine which implies the execution of motor skills. Changes produced by skills practice are the result of moving from an attentional processing situation to an automatic processing one. This transition could be represented by a segment of the learning curve, where the performance shows a little improvement but sustained growing along relative long practice periods. This could explain changes experienced by the patients as the program develops since they remember how to pose only after the name given by the instructor is heard [24].

With respect to the effects on anxiety and depression, contradictory results were achieved. This could be related to the fact that instruments used for measuring these variables were hetero - applied, and the fact that it could not be controlled that a relative or the caregiver were the ones who answer both measures. However, qualitative data reported by the caregivers showed a mood improvement -patient smile frequently and enjoy interacting with other people. Now, they walk in the house, while they slept all day before their participation in the treatment. Besides, mood improvement has been reported by other authors. De Gracia and Marcó found that regular physical activity practice, both aerobic and anaerobic -Yoga- could induce positive changes in mood of the sedentary aged [25].

Yoga effect on flexibility and equilibrium was evident. As people get older, these capacities are very important because articulations become rigid, and it is more probable to fell down.

According to these variables, there was a patient who did not present any change -the only person who did not attend sessions and suffered more physical deterioration-. Some authors have reported that Hatha-Yoga poses increase flexibility [13,17]. Equilibrium and flexibility improvement make possible to improve in other aspects such as instrumental functionality. From the caregivers report, it can be established that patients started to get dressed and stand up, sit down faster; moreover, to go into or out of the car more easily. Besides, these patients become tougher because they can walk faster, get less tired and have less possibility of falling down. In spite of the equilibrium poses difficulty, participants got a good performance without help. González, López, Trujillo and Escobar consider the healthy aged between 60 and 75 years old have a prevalence ranging from 15% to 30% of having a fall [26]. However, this percentage increases in people over 71 years old. So, having a fall is one of the main causes of disability in the aged [27].

One of the features of the program was precisely the simplicity of the instructions. Additionally, repeated practice and visual feedback, which are the two variables that have been considered as important in the relearning of motor skills of people with dementia [28]. In fact, Dick et al. [29] suggest that because Alzheimer's patients have problems with episodic memory, constant and consistent practice is more effective for the reason of the repeated execution of the same motor program does not require an intact episodic memory, or other skills that can be impaired in this population. The patients in our program were able to acquire the movements (positions) by a constant repetition, without showing awareness of learning from them. This ability of implicit learning, which is preserved in Alzheimer's patients, can be used as a starting point in non-pharmacological intervention programs.

Finally, the medical staff reported that patients presented slow movements, equilibrium problems, poor instructions monitoring and limited skills to develop positions at the beginning of the program. However, the final report indicates patients improved their positions and movement skills. Besides, patients improved instructions understanding and became more confident and prepared to do their work.

Despite the findings described above, the following limitations are important to consider in future work:

1. We used hetero applied instruments. The person who answered pre-tests and post-tests was not always the same.
2. Home extra sessions were not developed by all the participants.
3. Some instruments had a ceiling effect, which made it not possible to clarify quantitative changes exactly
4. The sample size.
5. There were not: waiting for a control group and aerobic control group.

In summary, our results in people with dementia showed beneficial effects of yoga on physical performance, these findings revealed a possible impact on functional abilities, self-esteem and level of independence in everyday life. However, because the type of instruments used and the disease process itself, it was not possible to determine effects in other areas. Even though it is important to highlight that this is a pilot study, which presented preliminary results indicating the importance of the scientific study in this area. In fact, even nowadays yoga is commonly

use to treat people with Alzheimer's (see, for example, in Pensacola, Florida—a class called “Super Brain Yoga”; in Washington the work held by Patrice Flesch and the proposal Dr. Khalsa), there is not yet enough systematic and controlled research clarifying the effects of yoga on a cognitive level.

It is relevant to project studies on this topic. First considering the effects of exercise on brain plasticity, and that exercise could work as a protective agent against degenerative processes. Second for the reason that Yoga has appropriate characteristics that can be practiced by older adults. Finally, because exercise and yoga seem to have cognitive effects [15] and cognition is one of the areas of greatest damage in people with dementia.

Future research proposals in this field should be under a mixed methodology approach that promotes a more detailed analysis of the final results and especially the process; from techniques as content analysis of instruments filled out by patients and caregivers, and the characterization and description of the errors committed by patients.

Despite the fact that working with people with moderate dementia is complex, proposing solid non-pharmacological intervention programs, provides an option for these forgotten human beings, even by their own memory. On the other hand, using ancient techniques like yoga, which has shown benefits in different populations by the combination of the triad: relaxation-breathing-relaxation, in a physical (postures) and cognitive (attention-concentration constant) context, it represents an option that worth studying, and to be validated with more consistent and ecological measuring instruments. All of this, directed to provide non-pharmacological programs that can provide alternatives interventions [30].

Acknowledgments

Dr. Camilo Povea, Dr. Mauricio Eraso and Dra. Adriana Hernández for their support. Dra. Victoria Arango and Dra. Angela María Orozco for their suggestions. Fundación Cardio Infantil –Instituto de Cardiología to approve this research, facilitate the installations and the patient's data bases. All these people and institution have made significant contributions to the study.

Disclosure Statement

Authors disclose any commercial associations that might create a conflict of interest in connection with this paper. No competing financial interests exist.

References

- Mangone CA (2004) Clinical heterogeneity of Alzheimer's disease. Different clinical profiles can predict the progression rate. *Rev Neurol* 38: 675-681.
- Peña J (1999) Las alteraciones psicológicas y de comportamiento de la enfermedad de Alzheimer. Gráficas Iberia S.A. Barcelona.
- Sanhueza M (2006) Aplicación de un Programa de Apoyo como Estrategia para Aumentar la Funcionalidad de Adultos Mayores.
- Colmenarejo J, Calle B, Sánchez J (2000) Valoración geriátrica exhaustiva: abordaje desde Atención Primaria. Una revisión actualizada.
- Puente C, Velasco L, Mercado F, Moreno R (2005) Comunicación, calidad de vida y satisfacción en pacientes con cuidados paliativos. *Psicología y Salud* 15 : 382-398.
- Chapman D, Marshall S, Strine T, Anda R, Moore M (2005) Dementia and Its Implications for Public Health. *Preventing Chronic Disease* 3 : 1-13.
- López O, Becker J (2000) Treatment of Alzheimer's disease. *Rev Neurol* 35: 850-859.
- Murillo-Hernandez A, Loo-Morales I (2007) Influencia de la práctica del ejercicio en la funcionalidad física y mental del adulto mayor Murillo-Hernández. *Revista de Enfermería del Instituto Mexicano del Seguro Social*; 15 : 11-20.
- Teri L, Gibbons L (2003) Exercise plus behavioral management in Patients with Alzheimer Disease. A randomized controlled trial. *Journal of the American Medical Association*; 290 : 2015-2022.
- Manoux A, Hillsdon M, Brunner E, Marmot M (2005) Effects of physical activity on cognitive functioning in middle age: evidence from the whitehall II prospective cohort study. *American Journal of Public Health*; 95: 2252-2258.
- Laurin D, Verreault R, Lindsay J, MacPherson K, Rockwood K (2001) Physical activity and risk of cognitive impairment and dementia in elderly persons. *Archives of Neurology* 58: 498-504.
- Insua M. Factores neurotróficos y ejercicio.
- Riley D (2004) Hatha Yoga and the treatment of Illnes. *Alternative Therapies in Health and Medicine* 10: 20-26.
- Michalsen A, Grossman P, Acil A, Langhorst J, Lütke R, et al. (2005) Rapid stress reduction and anxiety among distressed women as a consequence of a three-month intensive yoga program. *Medical Science Monitor* 11: 555-561.
- Oken B, Zajdel D, Kishiyama S, Flegal K, Dehen C, et al. (2006) Randomized, controlled, six-month trial of yoga in healthy seniors: effects on cognition and quality of life. *Alternative Therapy Health Medicine* 12: 40-47.
- Manjunath N, Telles S (2005) Influence of yoga y ayurveda on self-rated sleep in a geriatric population. *The Indian Journal of Medical Research* 12: 683-690.
- Donohue B, Miller A, Beisecker M, Houser D, Valdez R, et al. T(2006) Effects of brief yoga exercises and motivational preparatory interventions in distance runners: results of a controlled trial. *British Journal of Sport's Medicine* 40: 60-63.
- Harinath K, Malhotra A, Pal K, Prasad R, Kumar R, et al. (2004) Effects of hatha yoga and omkar meditation on cardiorespiratory performance, psychologic profile, and melatonin secretion. *Journal of Alternative and Complementary Medicine* 10: 261-268.
- Kaplan R, Sacuzzo D (2006) Pruebas psicológicas, principios, aplicaciones y temas. México: Thompson.
- Goldman S, Plum F (1997) Compensatory regeneration of the damaged adult human brain: Neuroplasticity in a clinical perspective. *Brain Plasticity Philadelphia* 99-107.
- Thornbury JM (1993) The use of Piaget's theory in Alzheimer's disease. *Am J Alzheimer Care and Related Disorders & Research* 7: 16-21.
- Matteson MA, Linton AD, Barnes S, Cleary BL, Lichtenstein MJ (1996) The relationship between Piaget and cognitive levels in persons with Alzheimer's disease and related disorders. *Aging Clin Exp Res* 8: 61-69.
- Peraita H, Moreno F (2006) Análisis de categorías semánticas naturales y artificiales en una muestra de pacientes de Alzheimer. *Psicothema* 3 : 492-500.
- Huertas E (1992) El aprendizaje no-verbal de los humanos. Madrid: Pirámide.
- De Gracia M, Marcó M (2000) Efectos psicológicos de la actividad física en personas mayores. *Revista Psicothema*; 12 : 285-292.
- González B, López V, Trujillo A, Escobar J (2005) Guía de practica clínica para la prevención de caídas en el adulto mayor. *Revista de Medicina del Instituto Mexicano del Seguro Social* 43: 226 – 252.
- Organización Panamericana de la Salud (OPS). Día Mundial de la Salud .
- van Halteren I, Scherder E and Hulstijn W (2007) Motor-Skill Learning in Alzheimer's Disease: A Review with an Eye to the Clinical Practice. *Neuropsychol Rev* 17: 203–212.
- Dick M B, Shankle RW, Beth RE, Dick-Muehlke C, Cotman CW, et al. (1996) Acquisition and long-term retention of a gross motor skill in Alzheimer's disease patients under constant and varied practice conditions. *Journal of Neurology* 51: 103–111.
- Luijpen MW, Scherder EJ, A Van Someren EJW, Swaab DF, Sergeant JA (2003) Non-pharmacological interventions in cognitively impaired and demented patients: a comparison with cholinesterase inhibitors. *Reviews in the neurosciences* 14: 343–368.