Health, 2016, 8, 1368-1380
http://www.scirp.org/journal/health
ISSN Online: 1949-5005
ISSN Print: 1949-4998

Motor-Cognitive Intervention in Mexican Older Adults

Luis Rendón-Torres[1], Bertha Cecilia Salazar-González[2], Esther Gallegos-Cabriales[2], Perla Lizeth Hernández-Cortés[2], Ernesto O. López-Ramirez[3], Marco Vinicio Gómez-Meza[4]

[1]Facultad de Enfermería, Universidad Autónoma de Tamaulipas, Laredo, Mexico
[2]Facultad de Enfermería, Universidad Autónoma de Nuevo León, Nuevo León, Mexico
[3]Facultad de Psicología, Universidad Autónoma de Nuevo León, Nuevo León, Mexico
[4]Facultad de Economía, Universidad Autónoma de Nuevo León, Nuevo León, Mexico
Email: bceci195@gmail.com

How to cite this paper: Rendón-Torres, L., Salazar-González, B.C., Gallegos-Cabriales, E., Hernández-Cortés, P.L., López-Ramirez, E.O. and Gómez-Meza, M.V. (2016) Motor-Cognitive Intervention in Mexican Older Adults. *Health*, **8**, 1368-1380.
http://dx.doi.org/10.4236/health.2016.813137

Received: August 31, 2016
Accepted: October 14, 2016
Published: October 17, 2016

Copyright © 2016 by authors and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/
Open Access

Abstract

Two motor-cognitive interventions were implemented to evaluate their efficacy in cognitive improvement in Mexican older adults 65 years and more. The intervention group received a dance video games plus a cognitive task (dual-task); the comparison group received only the dance video game, in sessions of 45 minutes, 3 times a week, for 12 weeks. The Barthel Index and Lawton and Brody Index, the Center for Epidemiologic Studies Depression Scale-Revised were applied the Digit Span Test, the Stroop Test, and Color Trail Making. Gait parameters were assessed by GAITRite® electronic walkway (CIR Systems). The design was quasi-experimental. Sites were randomly assigned to intervention groups. The intervention group started with 32 participants and finished with 15; the comparison group started with 20 participants and finished with 18. Participants in the intervention group had to mimic the dance movement of a video game and, after the second week to name progressively three objects without stopping dancing. A multivariate repeated measures model (MANOVA) was fit with four variables. A time-by-group interaction was observed in the Stroop test, and Digits Span Backwards was in favor of the dual task group. The Stroop test, Digit Span Backwards, gait speed, and step length showed effect time. Both groups improved in gait speed and step length by the end of the intervention. Results show it is feasible for Mexican older adults with little schooling to perform dual tasks and improve cognitive tasks and gait speed. Limitations were high attrition due to unforeseen situations and small sample size.

Keywords

Dual Task, Elderly, Cognition, Intervention Study

1. Introduction

According to the Encuesta Nacional de Salud y Nutricion [National Survey on Health and Nutrition] [1], the cognitive decline that occurs as age increases affects 7.3% of Mexican older adults: 6.3% of men and 8.3% of women. Cognitive decline affects social communication skills and the ability to fend for oneself [2].

Cognitive decline that affects quality of life of older adults and their families is directly associated to functional decline, which implies greater use of health services related to fractures, related to falls, and other adverse effects. Therefore, the research interest in improving the cognitive capacity in older adults has led to development of training programs focused on increasing their cognitive capacity; such programs have been found to be very useful for improving their quality of life also [3].

According to Gates and Valenzuela [4], several studies have focused on improving the cognitive abilities in older adults, concentrating on different types of interventions: motor, memory or reasoning, and dual-task interventions. Video games have been used in motor-cognitive interventions in older adults because of their low cost, ease of use, and portability [5]-[8]. However, the majority of interventions with exercises and video games have used the dual task for measuring gait as an outcome, but not as a component of the intervention.

The video game is a device that involves motor-cognitive activity, possessing the potential to help improve cognition and motor coordination in older adults. A dance video game (Nintendo Wii™) requires older adults to observe the movements of a dancer on the television screen and to simultaneously mimic the dancer implying well-coordinated movements, involving divided attention [6]. Although some studies have focused on improving balance in people with Parkinson's or in people with attention deficits [9], few studies have addressed cognitive improvement. Therefore, there are knowledge gaps with respect to the effect of interventions using video games plus dual tasks on improving cognitive abilities in older adults. The aim of the study was to test a cognitive-motor intervention with an additional cognitive task (dual-task) versus a simple motor-cognitive intervention on the cognition of older adults.

2. Material and Methods

A quasi-experimental study was conducted with an intervention group and a comparison group. The intervention group received a cognitive-motor intervention with a simultaneous cognitive activity (dual-task) for 45 minutes, three times a week, for 12 weeks; the comparison group received only a cognitive-motor intervention during the same period of time. Three measurements were performed on both groups: before starting the intervention, at the end of the sixth week, and at the end of the intervention at 12 week.

$$\frac{\mathbf{01}\quad \mathbf{X_1}\quad \mathbf{02}\quad \mathbf{X_1}\quad \mathbf{03}}{\mathbf{01}\quad \mathbf{X_2}\quad \mathbf{02}\quad \mathbf{X_2}\quad \mathbf{03}}$$

Older adults 65 years and older were selected from those attending clubhouses for older adults of the Desarrollo Integral para la Familia (DIF) [Comprehensive Development for the Family] of Monterrey, Nuevo Leon. Selection of participants was done through invitation non probabilistic; however, the assignment of the clubhouse to the intervention or comparison group was random.

Older adults who met the following criteria: oriented on time, space, and person; who had not participated in physical exercise programs within the last three months; and who planned to remain in the city for the next 12 weeks were admitted to the intervention groups. Additionally, if they were capable of walking without assistance (direct observation), and capable of distinguishing the movements on the screen (verified with each participant, with the movement of the participants coinciding with the dancer presented on the TV monitor), capable of hearing the interviewer's voice, and free of medical contraindications to performing exercise according to the Physical Activity Readiness Questionnaire (PAR-Q). Participant who did not me*et* all these criteria were excluded. Exclusion criteria were capillary blood glucose > 250 mg and blood pressure > 140/90 mm Hg.

Approval from the ethics committee of the School of Nursing of the Universidad Autoónoma de Nuevo León was obtained. All participants who met inclusion criteria and accepted to enter the study signed informed consent.

The intervention group and the comparison group began with 32 and 20 participants, respectively.

2.1. Data Collection Procedure and Measurements

All measurements were made at time 0 or baseline, at the end of week 6, and at week 12 after the intervention. Data were recorded for age, sex, years of schooling, marital status, occupation, weight, height, and presence of diseases such as diabetes, hypertension, and/or cardiac disease.

Functional status was measured by the Barthel Index and the Lawton and Brody Index, Spanish versions. The Center for Epidemiologic Studies Depression Scale-Revised (CESD-R) was used for assessing depressive symptoms, and a cognitive battery consisting of three instruments (the Digits Span Tests, the Stroop Test, and the Color Trails Test) was employed. The gait parameters were measured using the GAITRite® system electronic walkway (CIR Systems).

The Barthel Index assesses the autonomy of the individual to perform basic activities of daily living. Ten activities are measured: bathing, personal grooming, dressing, toilet use, use of stairs, urinary and anal sphincter control, feeding, transferring from bed to chair, and mobility. Its score ranges from 0 (completely dependent) to 100 points (completely independent). The cuttof points are <20 = total dependence, 20 - 40 = severe dependence, 45 - 55 = moderate dependence, and >56 = mild dependence. These points are used to describe participants. The Spanish version of the Lawton and Brody Index was used to evaluate the functional capacity of the OA to perform instrumental activities. It has eight domains, with values of 1 = independent and 0 = dependent. The score ranges from 0 to 8 points: 0 - 1 means total dependence, 2 - 3 severe dependence, 4 - 5 moderate dependence, 6 - 7 mild dependence, and 8: autonomous.

The Spanish version of the CESD-R was used to evaluate depressive symptoms [10], within the last seven days. It contains 20 items with Likert-type response options from 0 to 3 points: less than a day (0 points), 1 - 2 days (1 point), 3 - 4 days (2 points), and 5 - 7 days (3 points). The total score varies from 0 to 60, as follows: <15 points means no depressive symptoms are present; from 16 to 20 points, mild depression symptoms; from 21 to 25 points, moderate depression symptoms; and >26 points, symptoms of severe depression. In items 4, 8, 12, and 16, the score is reversed.

The Color Trails Test is a speed test of visual search, attention, mental flexibility, and motor function. The test consists of two parts, A and B, with the latter being more complex. Only data of Part B, which contains only numbers, are reported. The participant must connect the 25 numbers sequentially alternating the yellow and pink colors, for example, 1 yellow, 2 pink, 3 yellow, 4 pink, and so on. The score is expressed in terms of the time required to connect the 25 numbers, alternating the color. If there is an error, it is communicate to participant for correction while the timing continues.

The Stroop test consists of three parts. In the first test, the participant must read by columns the names of colors printed in black ink (Stroop-P) in 45 seconds. Each participant is indicated when to start and when to stop. If the participant reaches the end of the sheet and stop has not been indicated, he or she should start again with the first column. The number of words read correctly is counted. The second part involves the names of colors printed in different colors (Stroop-C). The participant is asked to name the color of each word printed, and the number correct answers in 45 seconds is scored. The third color-word test (Stroop-PC) also contains the words "red", "green", and "blue", printed in a color different from that corresponding to the written word. But now the participant must name the color of the ink with which the word is printed, ignoring the word. The number of correct answers, in 45 seconds, was registered for each participant.

The Digits Span test consists of two parts, one in progressive order and the other in reverse order [11]. It measures how much information a person can manage at once. The digits test in progressive order starts with a set of three digits and progresses up to a set of nine digits. The interviewer says the first set of three digits, one per second, and asks the participant to repeat them. For each set said correctly, one more digit is added. The number of digits repeated correctly is recorded. A score of 6 or more is within normal limits; 5 is marginal to normal limits; 4 is borderline; and 3 is defective. The higher the score is, the higher the attention capacity.

In the digits span backwards test, as previously, the series of digits is stated, but the participant must say them in reverse order; the last digit mentioned by the research assistant should be the first named by the participant, and so on. The number of digits repeated correctly in reverse order is recorded. A score of 4 to 5 is within normal limits; 3 is borderline defective; and 2 is defective. The higher the score is, the higher the attention capacity.

Gait speed cm/s, step length cm, step width cm, single and double support time s were measured using the GaitRite system, (mat of 5.50 m × 0.90 m with electronic sensors. Temporal and spatial gait parameters are registered and stored in software while participant walks on the mat. Values are exported to Excel and then to SPSS.

2.2. Equipment

Seven 32-inch televisions were used to facilitate older adults' visibility of the Nintendo Wii™ application. The video game "Just Dance" involves following the steps that a dancer makes on the screen; based on how each participant has performed, he or she is evaluated as PERFECT, GOOD, OK, or X. The equipment consists of an interactive video game that uses a wireless remote control distant from the television that detects movement and orientation in three dimensions by using accelerometers and a bar of sensors. Depending on the game that is being played back, the participants simulate movement similar to real-world activities.

Prior to the demonstration of the video game, the trained research assistant performed a practical example of movements, stating that they should be imitated. Each participant was introduced individually, and an equipment training session on how to use the Wii™ remote, how to navigate the menus, and how to play the game was provided. In the initial sessions, the research assistant helped them with the command to reset or change the dance.

Once the intervention group had mastered the video game and its implications, the simultaneous dual task was added. For the dual task, they were asked randomly to mention three nouns (object, animal, color, cities, among others) while imitating the movements that appeared on the monitor. A research assistant recorded whether the requested nouns were answered and the video game system registered if the participant continued imitating the movements correctly. As the weeks passed by, the number of questions increased. After the first two weeks of adaptation, five questions were asked. On the first day of the third week, a series of five questions was asked; on the second day, a series of sis questions was asked, and on the third day, a series of seven questions was asked, during 30 minutes of the intervention. From week 4 to the end, a series of 10 questions were maintained.

All participants were closely observed for signs of dizziness, fatigue and were asked to report their effort level (Borg scale) in the middle of each session. They were advised to sit down and rest for 2 minutes. No contingency was presented.

2.3. Minimization of Threats

To avoid influencing expected outcomes, the principal investigator (PI) did not participate in the measurements or in the intervention; but PI supervised the interventions. Research assistants received a training manual, and their roles were discussed with them. They were all tested, on both the application of the instruments and the intervention, until adherence to the manual and uniformity among the assistants was assured. For this purpose, the following checklist was developed: indications, application, and comments. To maintain the fidelity of the intervention, the principal investigator interviewed the participants randomly.

2.4. Data Analysis

The data was analyzed using the SPSS statistical package. Descriptive statistics was obtained to describe characteristics of participants and outcome variables. Kolmogorov-Smironov test with Lilliefors correction was used to test distribution normality of all variables. U Mann-Whitney test was use for baseline differences between the groups because variables did not show normal distribution. Multivariate repeated measures MANOVA were used to analyze intervention effects.

3. Results

Sixty-three participants were interviewed, of which nine did not meet the inclusion criteria. In the PAR-Q, they stated that the physician had advised them not to exercise because of cardiac problems. Two participants refused to enter the study. The intervention group and comparison group began with 32 and 20 participants, respectively. Of the intervention group, 17 participants abandoned the study from the second week to the sixth week. Some reasons were: unexpected trips, dislike, sicknesses, among others (Figure 1). Participants who drop out were not different on sociodemographic characteristics or measures.

The age and schooling of the participants by group was similar. A higher proportion of participants indicated suffering from hypertension than from diabetes mellitus type 2 only. Table 1 shows the sociodemographic data of the participants by group. With re-

Table 1. Descriptive data of the participants by group.

Variable	Intervention			Comparison		
	Mean	SD	Mdn	Mean	SD	Mdn
Age (years)	69.80	5.15	69	70.89	5.54	69.50
Years of Schooling	7.33	2.79	6	6.67	2.80	6.50
	f	%		f	%	
Male/Female	1/14	6.7/93.3		2/16	11.1/88.9	
Ocupation						
House hold	12	80		15	83	
Retired	3	20		3	17	
Civil status						
Single	2	6.3		1	5.6	
Married	15	46.9		7	38.9	
Widow/er	15	46.9		10	55.6	
Diseases						
None	7	46.66		12	66.66	
DMT2	2	13.33		0	0.00	
HTA	3	20.00		3	16.66	
Both	3	20.00		3	16.66	

Note: SD = Standard deviation, DMT2 = diabetes mellitus type 2, HTA = arterial hypertension.

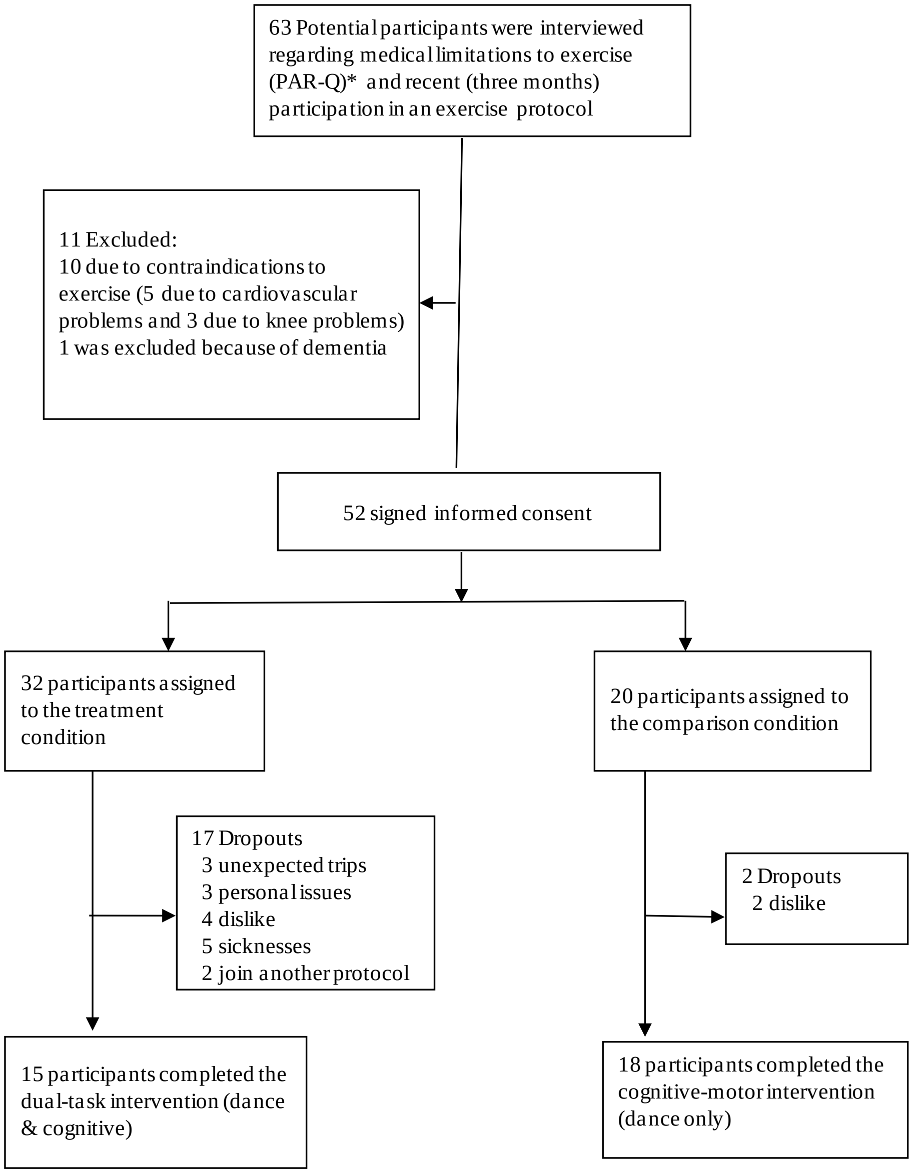

Figure 1. Flowchart of Participants. *PAR-Q = Physical Activity Readiness Questionnaire.

spect to basic and instrumental activities of daily living, all older adults, except for one woman were independent in all activities, thus they were not measured after the intervention. This woman said she needed some assistance going up and down stairs and when shopping. Therefore, these data are not provided.

The Mann–Whitney U tests were not significant, and thus, the groups were homogeneous in baseline measurements.

Table 2 presents the descriptive results of the cognitive tests according to measurement time. The Mann-Whitney U tests revealed that the groups were homogeneous.

The Mann-Whitney U test revealed no significant differences in symptoms of depression between the medians of the groups. With respect to the cutoff point of the instrument (less than 16 points), means of both group are observed below the cutoff

Table 2. Descriptive data of the cognitive tests by group.

	Intervention Group									
Measurement	Color Trails B		Progressive Digit Span		Backwards Digit Span		Stroop C		Stroop PC	
	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
Baseline	128s	50	5.67	1.23	3.67	0.72	75.33	18.40	25.73	9.61
6 week	116s	38	5.60	1.05	4.13	1.12	78.13	18.25	28.87	9.15
12 week	113s	34	5.67	0.81	4.80	0.41	80.73	11.06	30.73	8.80
	Comparison Group									
Baseline	156s	67	5.40	1.50	3.50	1.29	79.61	22.84	25.44	9.35
6 week	152s	66	5.00	0.97	3.56	1.04	77.50	19.82	24.56	8.45
12 week	158s	65	4.72	0.82	3.72	0.75	77.72	17.41	24.61	7.19

Unit of measure: Color Trails = seconds, Progressive Digit Span and Backwards Digit Span = number of digits remembered correctly, Stroop C = name of the color written in an ink different than the color, Stroop PC = correct number of mentions of the ink in which the name of the word (color) appears, SD = Standard deviation.

point. However, of all participants at the beginning, five qualified as mildly depressed (16 - 20 points), two as moderately depressed (21 - 25 points), and two as severely depressed (26 or more points). At the end of the intervention, only one of the individuals with baseline severe depression qualified as moderate; the rest remained without depression. In both groups, a decrease was observed in the total score of the CESD-R scale compared to baseline measurement. These data are not presented. Table 3 shows the depressive symptoms scores observed on the CESD-R.

Table 4 shows the descriptive data for the gait parameters.

A multivariate repeated measures model (MANOVA) was fit with two of the cognitive tests and two gait parameters: Stroop PC, digits span backwards, gait speed (cm/second), and step length (cm) (Table 5).

Table 6 shows the univariate contrasts of Stroop PC, digits span backwards, gait speed, and step length. A time-by-group interaction was observed for Stroop PC and for digits in reverse order (Figure 2). The effect of time in the four variables was observed; the intervention group improved significantly in all four, although gait speed improved in both groups by the end of the intervention (Figure 3).

4. Discussion

Both groups received motor-cognitive intervention, but the intervention group received an additional simultaneous progressive cognitive task. The learning principles of the Schema Theory [12] that guided this intervention were confirmed. According to Schema Theory [12], learning to perform the same movements as the dancer that appears on the TV screen corresponds to motor learning, which intervenes in the memory that produces the movement and the memory that evaluates its correction. When learning movements, the individual compares the movement produced with its feedback and the correction reference. The recall moves the limbs explosively, stopping the person when

Table 3. CESD-R score by group.

	Mean	SD	Min	Max	Mdn
Intervention Group					
Baseline	13.53	5.87	6	27	12.0
6 week	13.80	6.69	6	28	11.0
12 week	6.20	5.41	0	18	4.0
Comparison Group					
Baseline	12.77	7.13	3	33	12.5
6 week	13.44	6.94	6	33	12.5
12 week	6.61	5.80	0	24	5.5

Note: SD = standard deviation, Mdn = median.

Table 4. Descriptive data for the gait parameters.

Measurement	Gait Speed (cm/s)		Cadence (steps/minute)		Double support time (s)		Length (cm)	
	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*	$\bar{X}$	*SD*
Intervention Group								
Baseline	112.42	25.59	115.69	11.80	0.320	0.072	116.77	18.15
6 week	117.03	16.95	118.22	11.53	0.304	0.062	119.33	16.22
12 week	120.70	23.54	118.12	11.53	0.312	0.070	121.57	15.57
Comparison Group								
Baseline	107.23	16.95	114.42	12.77	0.317	0.070	112.17	10.38
6 week	107.34	16.94	113.61	13.18	0.326	0.082	113.19	10.55
12 week	111.03	17.04	115.50	12.38	0.330	0.075	114.99	11.89

Table 5. Multivariate analysis of variance model for repeated measures of the cognitive batteries and gait parameters.

Contrast Multivariate	Λ	F	Hypothesis df	Error df	p value	η^2
Between Subjects Effects						
Intercept	0.007	982.33	4	28	<0.01	0.993
Group	0.796	1.79	4	28	0.16	0.204
Intrasubject Effects						
Contrast Multivariate						
Time	0.509	2.89	8	28	0.02	0.491
Time X group	0.679	1.41	8	28	0.24	0.321

Table 6. Univariate tests of Stroop PC, digits span backwards, and gait speed.

Variable	Contrast	Hypothesis df	Mean Square	*F*	p value	n²
	Time	2	34.619	4.16	0.02	0.119
Stroop-PC	Time X Group	2	74.437	8.91	<0.01	0.224
	Error	62	8.307			
	Time	2	3.825	6.75	<0.01	0.179
Digiti Span Backwards	Time X Group	2	1.703	3.00	0.05	0.088
	Error	62	0.566			
	Time	2	302.646	3.41	0.04	0.099
Gait speed cm/s	Time X Group	2	54.983	0.62	0.54	0.020
	Error	62	88.544			
Step length cm	Time	2	119.099	4.24	0.02	0.120
	Time X Group	2	8.742	0.31	0.73	0.010
	Error	62	0.566			

Note: df = degrees of freedom.

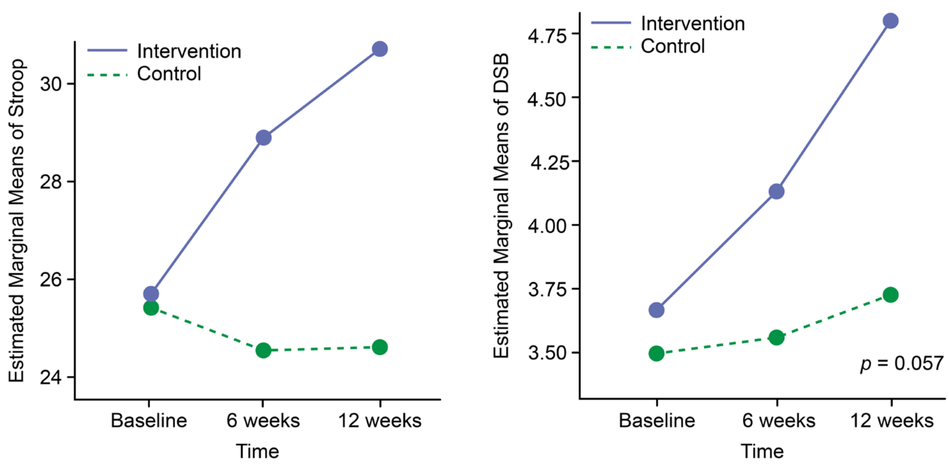

Figure 2. Time-by-group interaction: Stroop and Backwards Digit Span.

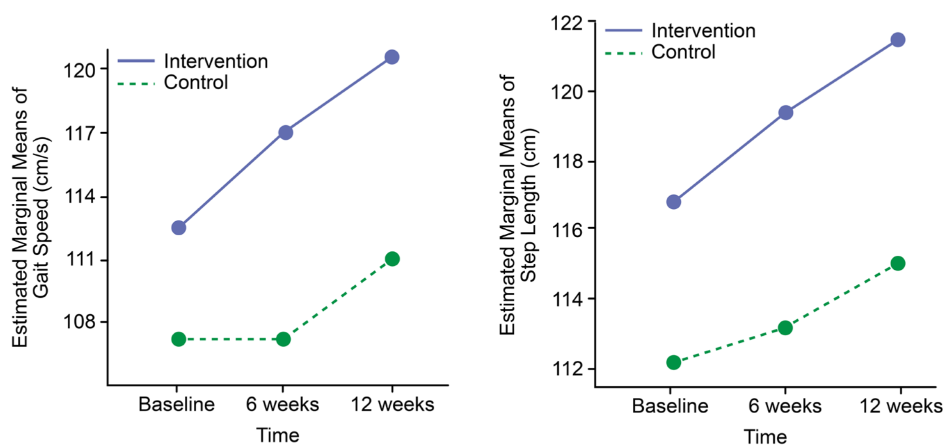

Figure 3. Time effect: Gait Speed and Step Length.

the movement produces feedback, which leads to remembering previous errors and the possibility of correction. The text that appeared on the TV screen according to their performance (PERFECT, GOOD, OK, or X) reinforced their feedback for mastering their dance movements. According to Pichierri, Murer, and de Bruin [6], the observation of the dance video game and the simultaneous imitation of the observed movements involve divided attention and thus is classified as motor-cognitive activity. As time went by, participants in both groups improved their movements and mimicked better the movements of the dancer observed on the TV screen.

The dual task intervention group improved over time in gait speed and step length, in backwards digit spans, and in the Stroop test. A time-by-group interaction was also observed for the Stroop test, and for digits span backwards in favor of the intervention group. The participants of the group who received only the motor-cognitive intervention, improved their gait speed and step length, but not in the cognitive tests.

The Stroop test involves the ability to adapt to changing demands and to suppress a habitual response in favor of a less common response [13]. Both the stroop test and the dual task involve concentration on a cognitive task to generate the correct answer. The number of digits recalled in reverse order suggested improvement in working memory and attention by the end of the intervention. This task involves retaining the information and processing it to manipulate it in reverse order [13], which is known as working memory and also implies attention as in the dual task. The attention capacity in older adults is required in virtually any everyday task; however, studies are needed to further explore whether the improvements obtained on cognitive tests translate into practical results.

The results confirm the findings of interventions with dance video games in older adults. For example, in de Bruin, Reith, Dörflinger, and Murer [14] and Pichierri, Murer and de Bruin [6], gait speed increased. Studenski *et al.* [8] also reported a significant improvement in cognitive performance, even on a different cognitive test (symbol digit substitution). Similar to this study, Theill, Schumacher, Adelsberger, Martin, & Jäncke [15], reported increases in pairs association and less variability of steps; that is, they obtained significant results on a memory task and a gait parameter. These authors implemented an intervention that simultaneously involved working memory performance and cardiovascular training in elderly adults. Fail to show improvements in the only video dance group might be explained to low years of school, and in Theill *et al.* [15] participants had higher means (13 years) of school.

Various studies show effects on different cognitive tests after exercise interventions [16]-[18], however, in this study, no significant differences were observed in the cognitive performance tests of the participants in the cognitive-motor intervention (dance). One difference with those studies is that they included memory tasks as part of the dual task measurement outcome; furthermore, in You *et al.* [17], the duration was six months. Maillot, Perrot, and Hartley [9] showed that intervention (motor-cognitive) with video games produced cognitive improvement. The latter authors combined four sports video games per session (Wii™ Ski Slalom, Wii™ Hula Hoop, Wii™ Trampoline, and Wii™ Tennis Return of Serve); the intensity and combination of the games probably stimulated cognitive performance. Other studies [18] [19] have shown results from various cognitive tests through physical exercise programs.

This study demonstrated the feasibility of a dual task using a dance video game and a cognitive task in older Mexican adults with little schooling. The results of this study suggest that the dance video game, considered a motor-cognitive intervention, is not sufficient for improving cognitive tests that required high attention and concentration which is also involve in a dual-task.

Some limitations of the study were the high attrition in the intervention group and the small sample size. The participants were not randomized, and thus, the results cannot be generalized. It is necessary to replicate the study—foreseeing no dropouts, increasing the sample size, and employing strategies for including more men (because older adult men either continue working or do not usually attend clubhouses for older adults).

References

[1] (2012) Encuesta Nacional de Salud y Nutricion [National Survey on Health and Nutrition]. p. 122.
http://ensanut.insp.mx/informes/ENSANUT2012ResultadosNacionales.pdf

[2] Mejía-Arango, S., Miguel-Jaimes, A., Villa, A., Ruiz-Arregui, L. and Gutiérrez-Robledo, L. M. (2007) Deterioro cognoscitivo y factores asociados en adultos mayores en México [Cognitiveimpairment and associatedfactors in olderadults in Mexico]. *Salud Publica Méx*, **49**, S475-S481.

[3] Jones, R.N., Marsiske, M., Ball, K., Rebok, G., Willis, S.L., Morris, J.N. and Tennstedt, S.L. (2012) The ACTIVE Cognitive Training Interventions and Trajectories of Performance among Older Adults. *Journal of Aging Health*, **25**, 186S-208S.
http://dx.doi.org/10.1177/0898264312461938

[4] Gates, N. and Valenzuela, M. (2010) Cognitive Exercise and Its Role in Cognitive Function in Older Adults. *Current Psychiatry Reports,* **12**, 20-27.
http://dx.doi.org/10.1007/s11920-009-0085-y

[5] Peretz, Ch., Korczyn, A., Shatil, E., Aharonson, V., Birnboim, S. and Giladi, N. (2011) Computer-Based, Personalized Cognitive Training versus Classical Computer Games: A Randomized Double-Blind Prospective Trial of Cognitive Stimulation. *NeuroEpidemiology*, **36**, 91-99. http://dx.doi.org/10.1159/000323950

[6] Pichierri, G., Murer, K. and de Bruin, E.D. (2012) A Cognitive-Motor Intervention Using a Dance Video Game to Enhance Foot Placement Accuracy and Gait under Dual Task Conditions in Older Adults: A Randomized Controlled Trial. *BMC Geriatrics*, **12**, 74.
http://www.biomedcentral.com/1471-2318/12/74
http://dx.doi.org/10.1186/1471-2318-12-74

[7] Smith, S.T., Sherrington, C., Studenski, S., Schoene, D. and Lord, S.R. (2011) A Novel Dance Dance Revolution (DDR) System for In-Home Training of Stepping Ability: Basic Parameters of System Use by Older Adults. *British Journal of Sports Medicine*, **45**, 441-445.
http://dx.doi.org/10.1136/bjsm.2009.066845

[8] Studenski, S., Perera, S., Hile, E., Keller, V., Spadola-Bogard, J. and Garcia, J. (2010) Interactive Video Dance Games for Health Older Adults. *Journal of Nutritional Health Aging*,

14, 850-852. http://dx.doi.org/10.1007/s12603-010-0119-5

[9] Maillot, P., Perrot, A. and Hartley, A. (2012) Effects of Interactive Physical-Activity Video-game Training on Physical and Cognitive Function in Older Adults. *Psychology and Aging*, **27**, 589-600. http://dx.doi.org/10.1037/a0026268

[10] Eaton, W.M. (2004) Center for Epidemiologic Studies Depression Scale: Review and Revision (CES-D and CESD-R). Maruish ME, Mhwah.

[11] Lezak, M. (1995) Neuropsychological Assessment. Oxford University Press, New York.

[12] Schimdt, R. and Lee, T. (2011) Motor Control and Learning: A Behavioral Emphasis. 5th Edition, Human Kinetics, USA.

[13] Strauss, E., Sherman, E.M.S. and Spreen, O. (2006) A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary. A Review. 3rd Edition, Oxford University Press, New York.

[14] de Bruin, E.D., Reith, A., Dörflinger, M. and Murer, K. (2011) Feasibility of Strength- Balance Training Extended with Computer Game Dancing in Older People; Does It Affect Dual Task Costs of Walking? *Journal of Novel Physiotherapies*, **1**, 104. http://dx.doi.org/10.4172/2165-7025.1000104

[15] Theill, N., Schumacher, V., Adelsberger, R., Martin, M. and Jäncke, L. (2013) Effects of Simultaneously Performed Cognitive and Physical Training in Older Adults. *BioMed Central Neuroscience,* **14**, 103. http://dx.doi.org/10.1186/1471-2202-14-103

[16] Nishiguchi, S., Yamada, M., Tanigawa, T., Sekiyama, K., Kawagoe, T., Suzuki, M., Yoshikawa, S., Abe, N., Otsuka, Y., Nakai, R., Aoyama, T. and Tsuboyama, T. (2015) A 12-Week Physical and Cognitive Exercise Program Can Improve Cognitive Function and Neural Efficiency in Community-Dwelling Older Adults: A Randomized Controlled Trial. *Journal of the American Geriatrics Society*, **63**, 1355-1363. http://dx.doi.org/10.1111/jgs.13481

[17] You, J.H., Shetty, A., Jones, T., Shields, K., Belay, Y. and Brown, D. (2009) Effects of Dual-Task Cognitive-Gait Intervention on Memory and Gait Dynamics in Older Adults with a History of Falls: A Preliminary Investigation. *NeuroRehabilitation*, **24**, 193-198.

[18] Voss, M.W., Heo, S., Prakash, R.S., Erickson, K.I., Alves, H., Chaddock, L., *et al.* (2013) The Influence of Aerobic Fitness on Cerebral White Matter Integrity and Cognitive Function in Older Adults: Results of a One-Year Exercise Intervention. *Human Brain Mapping,* **34**, 2972-2985. http://dx.doi.org/10.1002/hbm.22119

[19] Liu-Ambrose, T., Nagamatsu, L.S., Graf, P., Beattie, B., Ashe, M.C. and Handy, T.C. (2010) Resistance Training and Executive Functions: A 12-Month Randomized Controlled Trial. *Archives of Internal Medicine*, **170**, 170-178. http://dx.doi.org/10.1001/archinternmed.2009.494

Scientific Research Publishing

Submit or recommend next manuscript to SCIRP and we will provide best service for you:

Accepting pre-submission inquiries through Email, Facebook, LinkedIn, Twitter, etc.
A wide selection of journals (inclusive of 9 subjects, more than 200 journals)
Providing 24-hour high-quality service
User-friendly online submission system
Fair and swift peer-review system
Efficient typesetting and proofreading procedure
Display of the result of downloads and visits, as well as the number of cited articles
Maximum dissemination of your research work

Submit your manuscript at: http://papersubmission.scirp.org/
Or contact health@scirp.org