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Multi-domain intervention program on cognitive function in community-dwelling older adults: Pilot study

Programa de intervención multidominio sobre la función cognitiva en adultos mayores que viven en la comunidad: estudio piloto

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Abstract

Background: Recent interventions to prevent cognitive impairment include aerobic-cognitive training and educational programs on cognitive function.
Objective: To compare the effectiveness of a multidomain intervention and a sports program (control) on objective cognitive function (OCF), subjective memory function (SMC), frontal assessment battery, cognitive reserve, depression, anxiety, and stress in older adults through a non-randomized study.
Material and methods: The intervention consisted of aerobics and cognitive exercises (exercise on a checkered mat) and educational motivational support. The intervention group received 60 minutes of training 3 days a week for 24 weeks, and the control group 60 minutes of physical training 2 days a week for 24 weeks. Independent older adults were included. The baseline and final values of the outcome variables were obtained. The relative risk for SMC, as well as the median differences, the effect estimate, and ANCOVA for continuous variables were obtained.
Results: The characteristics of the intervention group (*n* = 11) and control group (*n* = 10) were similar at baseline, except for age. OCF, SMC, and neuropsychological symptoms showed a positive trend in the intervention group, whereas in the control group did not. The intervention was significant in SMC (RR: 0.5; 95%CI 0.4-0.8), and the control showed a substantial decrease in OCF compared with the intervention group [F(1) = 8.4; *p* = 0.009; n.p = 0.30].
Conclusions: The results suggest that the 3-component program may be more effective than the control program in improving SMC and OCF.

Resumen

Introducción: las intervenciones recientes para prevenir el riesgo de deterioro cognitivo incluyen entrenamiento aeróbico-cognitivo y programas educativos sobre la función cognitiva.
Objetivo: comparar la efectividad de una intervención multidominio y un programa deportivo (control) en la función cognitiva objetiva (FCO) y la función subjetiva de memoria (SMC), batería de evaluación frontal, reserva cognitiva, depresión, ansiedad y estrés en adultos mayores mediante un estudio no aleatorizado.
Material y métodos: intervención de ejercicios aeróbicos y cognitivos (ejercicio sobre un tapete cuadriculado) y apoyo motivacional educativo. El grupo intervención recibió 60 minutos de entrenamiento por 3 días a la semana durante 24 semanas y el grupo control 60 minutos de entrenamiento físico por 2 días a la semana durante 24 semanas. Se incluyeron personas adultas mayores independientes. Se obtuvieron valores basales y finales de las variables resultados. Se estimó riesgo relativo para SMC y las diferencias de mediana, del efecto y ANCOVA para variables continuas.
Resultados: las características de grupo de intervención (*n* = 11) y control (*n* = 10) fueron similares al inicio, excepto la edad. La FCO, SMC y los síntomas neuropsicológicos mostraron tendencia positiva en el grupo de intervención y el grupo de control no. La intervención fue significativa en SMC (RR 0.5; IC 95% 0.4-0.8) y el control disminución en FCO en comparación con el grupo de intervención [F(1) = 8.4; *p* = 0.009; n.p = 0.30].
Conclusiones: los resultados sugieren que el programa de intervención de 3 componentes puede ser más efectivo que el programa control para mejorar la FCO y la SMC.

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Background

Cognitive impairment in the elderly is a risk factor for dementia.[1] The causes of disability among older people represent a disease burden for their health systems and families of older adults.[1,2] The concern is that 60% of cases are found in low- and middle-income countries.[1,2] A meta-analysis published in 2022 reported that the highest prevalence of dementia in Latin America and the Caribbean was 8.16%, whereas in Mexico was 7.9%, with rural areas contributing to more cases.[3,4] Dementias mean that patients' families and health services incur catastrophic costs because no specific treatment is provided.[1]

Several observational studies have identified modifiable risk factors, and randomized clinical trials in people without dementia have suggested that multidomain interventions may improve cognitive performance.[1] Twelve risk factors have been reported for dementia: low academic level, hearing loss, traumatic brain injury, hypertension, excess alcohol intake, obesity, smoking, depression, physical inactivity, social isolation, diabetes, and environmental pollution,[1] factors that can be changed to an attributable population fraction of 41.5%.[2] Therefore, it is possible to prevent dementia in as many as 40% of cases. In Latin America, 56% of cases are avoided.[3] Cohort studies have shown that modifying risk factors is a preventive alternative for reducing neuropathological damage (such as the accumulation of amyloid β, tau protein, vascular injury, and inflammation) and increasing or maintaining cognitive reserves.[1,2]

Cognitive stimulation, nutrition, physical exercise, and multiple domains have recently been included in interventions to prevent dementia because they have achieved the best results in decreasing risk factors for dementia.[5] The critical point for preventing dementia is in participants with intact cognitive function and those at risk.[5]

Moderate and light physical activity is an effective intervention for preventing cognitive impairment and reduces the risk of falls by 30%,[6,7] consequently improving activities of daily living. Aerobic exercise causes energetic stress in the peripheral tissue and brain, stimulates adaptive mechanisms, such as the metabolic, mitochondrial, and cellular mechanisms,[8] and improves the management of cardiovascular risk factors (e.g., diabetes, high blood pressure, dyslipidemia, and obesity), which are traditionally associated with poor cognitive performance.[7,8]

Square-stepping exercise (SSE) is a cognitive exercise on a 2.5 x 1.0 m mat and contains 40 squares drawn inside (25 x 25 cm). It is a low-tech and inexpensive exercise mode without a risk of injury.[6] It includes 3 difficulty levels (basic, intermediate, and advanced) in 200 cognitive patterns. The first is the prevention of falls, whereas the latter shows cognitive improvement.[6,9] Studies indicate that multi-domain interventions of 24 weeks, including aerobic and cognitive training with SSE, can enhance cognitive function, mobility, and vascular health in adults aged 55 with self-reported cognitive complaints. A pilot study also suggests potential improvements in executive function in older adults with type 2 diabetes.[10]

Interventions with educational programs are crucial for enhancing health literacy, a social factor that extends benefits from individuals to communities and healthcare systems. In dementia, prioritizing active aging, nutrition, physical activity, brain health improvement, and adherence to interventions is essential.[11]

We have proposed a multi-domain program that we call "Mind and Movement for Cognitive Health (intervention)," which has 3 components (aerobic exercise + SSE + educational program) to improve risk factors for dementia.[9] Therefore, this study aimed to evaluate the effectiveness of a 24-week multi-domain intervention on cognitive function among community-dwelling older adults, given that the recommendations from the European Task Force for Brain Health Services for dementia prevention are to reduce risk through multi-domain interventions and cognitive improvement with cognitive and physical training.[1]

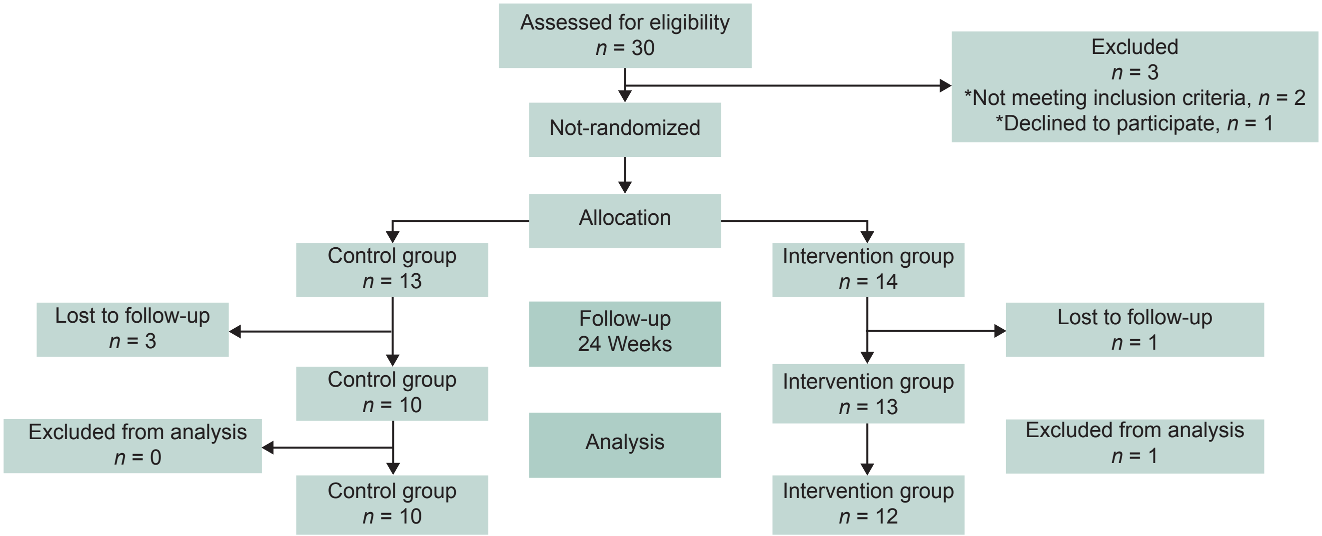
Material and methods

Study design and participants

A quasi-experimental study compared 2 groups and was blinded for clinical monitors (single-blind). The research team invited all older adults to participate in a physical activity program at a sports center in Southern Mexico City (see Figure 1). Those who provided informed consent were included as study participants, while those who did not complete the study were excluded. The participants' choices determined the group assignments.

Inclusion criteria were individuals between 60 and 85 years of age with a Mini-Mental State Examination (MMSE) score > 24,[11] capable of performing independent basic and instrumental activities of daily living, and without delirium. The exclusion criteria were as follows: I) clinically significant neurological or psychiatric disorders (e.g., Parkinson's disease and schizophrenia), II) a recent severe cardiovascular event (e.g., myocardial infarction or cerebrovascular accident), III) primary orthopedic conditions (e.g., severe osteoarthritis), IV) uncontrolled blood pressure (i.e., very high > 180/100 mmHg or very low < 100/60 mmHg), V) severe

Figure 1 Flow of participants



visual or hearing disability, and vi) unwillingness to comply with the exercise programs of this project. Older adults who did not attend at least 80% of the intervention sessions were excluded from the analysis.

Intervention and control programs

The intervention was integrated into the senior citizen program of a sports center located in the south of Mexico City, which has been in operation for the past 15 years. Senior citizens are enrolled in various physical activities, such as yoga, Tai chi, and swimming. Participants can attend any activity twice weekly without enrolling in a specific activity. In addition, senior citizens celebrate holidays on special occasions. All participants were invited to take part in the study. The participants who preferred to continue their usual activities without change were assigned to the control group. This group was assessed only twice: at the beginning of the study (time zero) and again at 24 weeks, without participating in the active intervention.

The intervention group participated in a multi-component program (aerobic exercise, SSE, and educational support) developed by the Mexican Institute for Social Security (IMSS, *Instituto Mexicano del Seguro Social*) in a strong collaboration with the School of Health and Sports Sciences at Chukyo University, Japan.[9] The program included 60 minutes of aerobic-cognitive training, with a five-minute warm-up that included static and dynamic movement exercises, 30 minutes of aerobic exercises, including walking exercises and raising arms and legs, designed to achieve 65-75% of a predicted heart rate maximum (220-age), 20 minutes of SSE with 3 levels of progression (essential, intermediate, and advanced), and a 5-minute cool-down period. This routine was performed 3 days a week until completing 24 weeks. All exercises had an effort level of less than 5 on the modified Borg index. Health professionals provided weekly educational sessions (10-15 min). The educational program included active aging, sports, healthy eating, health, and socialization.

Dropouts from the program were monitored, as shown in Figure 1. Adverse events, including number, type (dizziness, pain, fatigue, muscle strain, falls, or injury), and severity were recorded during the exercise sessions. The severity of events was classified as mild (does not affect activities of daily living), moderate (has a significant average effect on activities of daily living), or severe (requires hospitalization, results in persistent or significant disability, or life-threatening or other medically critical conditions). Adherence to the program was defined as ≥ 80% compliance with the assigned physical training regimen. The study outcome variables were assessed at 0 and 24 weeks, whereas the covariates were only collected at baseline. The research staff was not blinded to the assigned groups.

Outcome variables

Primary outcomes

Global cognitive function was quantified using the MMSE on a scale of 0 to 30[12] and the Montreal Cognitive Assessment (MoCA) test on a scale of 0 to 30 points.[13] Frontal Assessment Battery explored the proper functions of the frontal lobes: similarities (concept formation), verbal fluency (mental flexibility), motor series (programming), interference (conflicting instructions), control (response inhibition), and autonomy (independence from the external environment).

The maximum possible score is 18 points.[14] Memory-based cognitive reserve was assessed using selected dimensions from the Cognitive Reserve Questionnaire (CRQ).[15,16] These dimensions include formal academic background (elementary, primary, junior, and senior high school, higher education); parents' formal and highest academic background (homeschooling, elementary and high school, or higher education); formal training courses in the classroom or online (none, 1-2, 3-5, and > 5); occupation (unskilled, skilled, administrative, professional, and management); formal or informal music training (does not play at all, plays a little or amateur, self-regulated musical training); conversational language proficiency (1 language or mother tongue, 2 languages, 3 languages, > 3 languages); reading habits (never, occasionally, 2-5 books a year, 6-10 books a year, > 10 books a year); and cognitive mind games such as Sudoku, crossword, memory games, etc. (never, occasionally, regularly). The final CRQ classification comprises 4 cognitive reserve categories: low range, low-medium range, high-medium range, upper range.[15,16] The presence of a subjective memory complaint was dichotomously quantified using the following probing question: (I) Do you have difficulty remembering things? (II) Do you feel that you forget your conversations? (III) Have you asked the same question multiple times? (IV) Have you recently forgotten to turn off your stove? (V) Do you believe you have memory problems? Participants were required to answer "Yes" or "No" for each probing question, and responses were dichotomized into a binary variable for analysis.[17]

Secondary outcomes

Neuropsychiatric symptoms were assessed using 3 different scales. Depression was assessed using a method described by Yesavage *et al.* The Geriatric Depression Scale includes 15 items, with scores from 0 to 15 points.[18] Anxiety was assessed using the Beck Anxiety Inventory (BAI), which consists of 21 questions about symptoms experienced in the last week, with scores ranging from zero to 63 points.[19] Stress was assessed using the 14-point version of the Perceived Stress Scale (EEP-14), which evaluates the perception of stress during the last month. Each question had 5 answer options, ranging from 0 to 4.[20] Lower scores indicate better status on all 3 scales.

Demographic, clinical, and biochemical characteristics of the participants were recorded, including age (years), sex (male or female), education (years), marital status (married, common-law marriage, widowed, divorced, or single), current employment status (unqualified, qualified manual, qualified non-manual, professional), smoking and alcohol status, living alone (yes or no), social health insurance (IMSS, Institute for Social Security and Services for State Workers [ISSSTE], Mexican Petroleum [Pemex]), self-reported diabetes mellitus, hypertension, obesity (body mass index [BMI] ≥ 30), instrumental activities of daily living (Lawton index ≤ 8 points), basic activities of daily living (Katz index ≤ 6 points), fasting glucose (mg/dL), triglycerides (mg/dL), cholesterol (mg/dL), HDL (mg/dL), and LDL (mg/dL). All characteristics were evaluated prior to the intervention.

In this pilot study, sample size calculation was considered a hypothesis of superiority at 0.05 ($\delta = 0.05$), type I error rate $\alpha = 0.05$, and power, $1-\beta = 0.80$. Also, the ratio of the case to control k = 1 and drop rate of 30%. The difference ($d = \mu T - \mu C$) and standard deviation (SD) between groups: a) objective cognitive function $d = 1.0 \pm 0.30$; b) depression and c) anxiety $d = 0.66 \pm 0.25$, and d) stress $d = 1.3 \pm 0.4$. The sample size for intervention and control groups $n_a = 7$; $n_c = 44$; $n_d = 44$; $n_e = 5$ respectively (https://riskcalc.org/samplesize/).[21] Wilson and Morgan mention that for ANOVA or MANOVA, a minimum of 7 participants per cell will yield approximately 50% power when the effect size is 0.50. Although small frequencies can inflate the type I error rate for categorical variables, a conservative rule is to have a frequency of at least 5 participants.[22]

Statistical analysis

We conducted a descriptive analysis of each group's characteristics. The chi-square test was used to determine differences in the proportions of discrete variables. For continuous variables, the Kolmogorov-Smirnov normality test was applied. The mean and SD were calculated for normally distributed variables, while the median and the 25th and 75th percentiles were used for non-normally distributed variables. Differences in normally distributed variables were analyzed using the Student's *t* test, whereas the Mann-Whitney *U* test was used for non-normally distributed variables.

Changes in cognitive function and neuropsychological variables were observed in the intervention and control groups intragroup (final-baseline). The continuous variable, which was not a normal distribution, was tested with the Wilcoxon test. The impact of the intervention or control was calculated using Cohen's *d* test and a 95% confidence interval. Cohen's *d* values of 0.20, 0.50, and 0.80 were considered small, medium, and large effect sizes, respectively.

Comparisons between groups were analyzed by examining the differences in the medians of outcomes (cognitive and neuropsychological function) and using a univariate generalized linear model (fixed factors) with between-subjects effects tests. The F value (ANOVA), *p* value, and partial eta squared were reported. Assumptions were checked using the homogeneity of variance test and Levene's equality of error test ($p > 0.05$). Additionally, the interaction between time and age was included in the model (ANCOVA).

The relative risk (RR) was calculated for dichotomous variables, such as subjective memory complaints, using the Mantel-Haenszel test, with a p value < 0.05. Differences were considered statistically significant with a $p < 0.05$.

Additionally, the interactions between covariates were assessed. The analysis was performed using SPSS, version 23.0.

Results

Out of the 30 individuals recruited, 27 (77%) agreed to participate in the study. Among the 27 participants, 16 chose the intervention program, and 11 chose the control program. In the control group, 6, 5, and 2 individuals practiced Tai chi, yoga, and swimming. Both groups were comparable in terms of their characteristics, including sex, education, marital status, smoking, alcohol consumption, physical activity, living alone, occupation, social health insurance, comorbidity, and basic and instrumental activities of daily living, except for age ($p < 0.05$), where the control group was older (see Table I). During the study period, 4 participants in the intervention group dropped out because of conflicts with their schedules, and 1 participant in the control group dropped out because of relocation.

Table II presents the baseline and final values for each group. The intervention group showed positive changes; that is, the effect size for global cognitive function with MMSE, MoCA, and FAB was between 0.2 and 0.4; for symptoms of depression and anxiety, it was between –0.6 and –0.8; and for stress, it was 0.6; whereas the control group exhibited negative changes, that is, for global cognitive function, it worsened for MMSE and MoCA with effect sizes between –1.1 and –0.5, respectively; and also, the symptoms of depression and anxiety did not improve between 0.3 and 0.4, respectively, although most variables did not show significant differences. The interaction between group and time was significant for global cognitive function (MSSE) ($F(1) = 8.4$, $p = 0.009$, η.p = 30), indicating that cognitive function in the intervention group improved with a small effect size. Analysis of covariance (ANCOVA) revealed that controlling for age had no significant effect on the intervention ($F(1) = 1.4$, $p = 0.206$, η.p = 0.14).

Discussion

This pilot study demonstrated that the 3-component program significantly improves subjective memory complaints and global cognitive function. In contrast, the control group showed a statistically significant deterioration in objective cognitive function. This quasi-experimental study indicates that the pilot study has a preferred effect on cognitive function.

The intervention group engaged in aerobic exercise, cognitive exercise (square-stepping exercise), and specific motivational support for 60 minutes a day, three days a week, over 24 weeks. In contrast, the control group participated in Tai chi, yoga, or swimming for 60 minutes and participated in various social activities twice a week for 24 weeks. The main differences between the training and control protocols were the absence of specific motivational support (health topics), the SSE in the control group, and the difference in training intensity (3 days per week for the intervention group versus 2 days per week for the control group).

The intervention is designed to prevent cognitive impairment and comprises 3 components: aerobic activity, cognitive training, and a motivational-educational program. Multi-domain interventions that have achieved beneficial results typically include physical activity, cognitive training, nutrition, chronic disease management, socialization, emotional support, and smoking cessation. Currently, the most successful programs are the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER),[23] a study to prevent cognitive decline in older people at risk from the general population, a 2-year multi-domain intervention (diet, exercise, cognitive training, vascular risk monitoring) that showed changes in total neuropsychological test Z score per year compared with the control group of 0.022 (95% CI 0.002-0.042, $p = 0.030$)[23] and the French Multi-domain Alzheimer Preventive Trial (MAPT) showed that the cohesion of multi-domain intervention domains —cognitive training, nutritional counselling, and increased physical activity— is more critical than omega-3 supplementation in improving lifestyle and limiting cognitive decline in adults with memory complaints.[24,25]

Our proposal includes an educational and motivational program for the physical-cognitive intervention. Additionally, once a week, we offered short conferences on topics such as active aging, sports, health, and socialization to support the intervention. Other studies have found that a combination of aerobic exercise and cognitive training is beneficial for cognitive function.[26,27] This intervention has been shown to decrease the risk of cognitive deterioration or dementia and improve executive function, memory, and attention in healthy older adults and those with diseases.[28] Recent evidence has also demonstrated benefits for brain health at molecular, structural, and psychosocial levels.[29]

In older adults, aerobic exercises increase brain-derived neurotrophic factor (BDNF) and insulin-like growth factor 1

Table I Sociodemographic characteristics, comorbidity, and functionality of the intervention and control groups

Characteristic	Intervention group *n* = 12	Control group *n* = 10
Age (years)	66.8 ± 4.5	75.3 ± 5.7*
Female ratio	83.3%	88.9%
BMI	28 .1 ± 4.9	27.3 ± 5.5
Education		
Primary school or less	25.0%	55.6%
Secondary school	16.7%	11.1%
High school degree	8.3%	22.2%
College degree	41.7%	0.0%
Postgraduate degree	8.3%	11.1%
Marital status		
Single, widowed, divorced	41.6%	55.6%
Married or common-law marriage	58.4%	44.4%
Occupation		
Unqualified (including domestic labor)	30.0%	37.5%
Qualified manual	10.0%	25.0%
Qualified not manual	10.0%	25.0%
Professional	50.0%	12.5%
Smoking	0%	11.1%
Alcohol	50.0%	44.4%
Living alone	11.1%	16.7%
Social Health Insurance (IMSS; ISSSTE, and PEMEX)	88.9%	66.7%
Comorbidity		
Diabetes	25.0%	30.0%
Hypertension	60.0%	37.5%
Obesity	40.0%	25.0%
Cognitive function (MMSE score)	26.0	27.4
Cognitive Funtion (MoCA score)	23.5	21.9
Instrumental activities of daily living (independent)	88.9%	83.3%
Basic activities of daily living (independent)	100%	100%
Glucose (mg/dL)	114.5 ± 21.9	106.2 ± 23.3
Cholesterol (mg/dL)	168.5 ± 47.8	200.7 ± 18.2
Triglycerides (mg/dL)	110 (82.0-156.0)	157.5 (120.3-173.4)
HDL (mg/dL)	42.2 ± 5.0	44.8 ± 8.4
LDL (mg/Dl)*	95 (69.2-1530)	126.5 (121.8-146.0)

IMSS: Mexican Institute for Social Security; ISSSTE: Institute for Social Security and Services for State Workers; Pemex: Mexican Petroleum; MMSE: Mini-Mental State Examination; MoCA: Montreal Cognitive Assessment
*$p < 0.05$

(IGF-1). Improved mechanisms reduce brain inflammation in glial cells and oxidative stress and increase neuronal connectivity, neurogenesis, DNA repair, homeostasis, and mitochondrial function. At the structural level, the hippocampus, cortex, and white matter volumes are maintained.[7,8]

In addition, 30 minutes of aerobic physical activity reinforces cognitive function through a 20-minute cognitive training session with the SSE, which represents optimal exercise for older adults because it is easy to practice and train cognitive stimulation through repetition, learning, and attention. Therefore, it is possible to improve activities of daily living, provide emotional support, and improve the quality of life of older people.[29]

Assessment using the MMSE, MoCA, FAB, and cognitive reserve showed beneficial results for MeMo-Health-Cog-3, with a small-to-medium effect size (0.2-0.5), whereas the values for the control group were negative, with a large effect size (–1.1-0.5). Improvements were also observed in FAB and cognitive reserve, with a small effect size in both groups. The control group exhibited a continued cognitive impairment due to aging.

Table II Changes in cognitive function and neuropsychological variables between the intervention and control groups

	Intervention group *n* = 12					Control group *n* = 10					ANCOVA	
Outcome	Baseline (B)	Final (F)	(F-B)	*p*-value*	Cohen's d (95% CI)	Baseline (B)	Final (F)	(F-B)	*p*-value*	Cohen's d (95% CI)	Group-time F(1) *p*-value;np	Intervention-age *p*-value F(1);*p*-value;np
Continuous												
Global cognitive function (MMSE)	25.8 ±1.6	26.5 ± 2.4	0.7	0.227	0.4 (-1.0, 1.3)	27.4 ± 2.1	25.5 ± 1.6	–1.9	0.011	–1.1 (–2.0, 0.1)	8.4;0.009;0.30	1.4;0.261;14
Global cognitive function (MoCA)	23.5 ± 3.1	22.3 ± 4.1	1.2	0.271	0.3 (-1.4,2.7)	21.9 ± 3.8	20.2 ± 3.8	–1.7	0.202	–0.5 (–2.3, 1.3)	0.5;0.841;0.02	0.3;0.972;0.3
FAB	14.5 ± 2.8	15.1 ± 2.7	0.6	0.344	0.2 (-1.3, 1.8)	13.8 ± 3.4	14.4 ± 2.1	–0.6	0.593	0.2 (–2.3, 1.1)	0.9;0.376;0.8	0.4;0.656;0.1
Cognitive reserve	9.3 ± 3.9	11.3 ± 4.6	2.0	0.032	0.5 (-2.1, 2.7)	8.3 ± 4.1	9.7 ± 5.0	1.4	0.083	0.2 (–4.4, 2.7)	0.2;0.707;0.1	0.8;0.453;0.1
Depression	4.5 ± 4.0	2.58 ± 3.3	-1.9	0.180	-0.6 (-2.4, 1.9)	3.6 ± 2.6	4.8 ± 6.5	1.2	0.888	0.3 (–3.8, 1.9)	3.9;0.07;0.26	4.8;0.034;0.49
Anxiety	5.1 ± 6.4	1.9 ± 2.0	-3.2	0.083	-0.8 (-1.9, 3.1)	4.2± 3.9	7.4 ± 10.4	3.2	0.833	0.4 (–6.3, 2.8)	0.0;0.940;0.01	0.7;0.930;0.3
Stress	28.0 ± 7.1	31.3 ± 4.3	3.3	0.222	0.6 (-1.9, 4.6)	27.9 ± 7.7	35.8 ± 7.5	7.9	0.050	1.1 (–3.6, 5.9)	1.1;0.349;0.18	0.4;0.716;0.2
Discreet												
SMC	58%	25%	33%	0.035	-	60%	70%	10%	0.937	-	0.4 (0.2, 0.5)*	

RR (95% CI); MMSE: Mini-Mental State Examination; MoCA: Montreal Cognitive Assessment; FAB: Front Assessment Battery; SMC: subjective memory complaints
*Wilcoxon signed-rank test

This study is the first multi-domain program developed in Mexico to prevent cognitive impairment through aerobic exercises, mental training, and an educational program. In other studies: a) aerobic activity combined with cognitive training with SSE was applied for 6 months to individuals at risk of cognitive impairment, physical state (VO_2 Max), diastolic blood pressure, and improved executive function. This effect was maintained for 28 weeks after intervention.[10] b) The effect of an intervention with aerobic exercise combined with SSE in patients with subjective memory complaints reported for cognitive function by MoCA was similar to our study.[30]

This pilot study must consider several limitations: a) its quasi-experimental design excludes randomization. This introduced selection bias, as the control group was older and, therefore, more likely to have neurological damage. Although the initial MMSE and MoCA scores showed similar average cognitive function between the groups, the control group experienced a faster rate of cognitive decline. b) Another aspect to consider with this bias is that people who chose to participate in the intervention may have been more motivated or have different characteristics (such as a greater interest in improving their health) than those who opted for the control group and, on the other hand, the activities of the control group are not controlled for intensity, duration or educational content, which makes it difficult to attribute the observed effects exclusively to the proposed intervention. c) The study's limited sample size reduces its statistical power to detect significant differences and increases the possibility of type II errors (failing to detect an effect that exists). d) As for losses, there were more in the control group than in the intervention group, which may bias the results towards a more motivated or healthier group.

This was a pilot study, which also allowed consideration of other aspects for its application in future studies. One very important element was the weekly progression of the patterns, which the participants learned without difficulty.

No adverse effects were reported with the aerobic exercise routine plus walking. With all this, applying the multi-domain intervention in future phase III studies is now possible.

Conclusions

The results suggest that the 3-component program may be more effective than the control program in improving global cognitive function and subjective memory. In controlled studies, this program could demonstrate efficacy in preventing cognitive decline in older adults at risk due to age.

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