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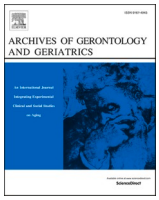

Effects of cognitive stimulation program on cognition and mood in older adults, stratified by cognitive levels: A randomized controlled trial☆

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ABSTRACT

Purpose of the research: Cognitive stimulation (CS) is defined as activities that involve cognitive processing, usually conducted in a social context and often in a group. This study aims to evaluate the effects of a personalized-adapted CS program in older adults on global cognition, neuropsychological constructs, activities of daily living (ADLs), and mood.

Materials and methods: The randomized controlled single-blind trial involving 337 participants (235 women and 102 men) ≥ 65 years of age in a Primary Care centre classified participants into 4 groups: 101 for the no deterioration (ND) group; 100 for the subjective cognitive impairment (SCI) group; 108 for the level deterioration (LD) group and 28 for the moderate deterioration group. The intervention consisted of a personalized CS adapted program for 10 weeks. Follow-up assessments were conducted post-intervention, and at 6 and 12 months. The primary outcome was global cognition measured by the Spanish version of the Mini-Mental State Examination. The secondary outcomes were measured by the Barthel Index, the Lawton and Brody Scale, the Goldberg Questionnaire (anxiety sub-scale) and the abbreviated Yesavage Geriatric Depression Scale.

Results: The intervention showed a tendency of improvement on global cognition and different cognitive functions for groups with no deterioration or level deterioration. The group with moderate deterioration improved in anxiety.

Conclusions: The findings demonstrated benefits in global cognition, different cognitive functions, semantic fluency, IADLs and anxiety. The most benefits are given in the intermediate groups, SCI, and LD. Moreover, the intervention works by increasing the benefits in the different phases.

1. Introducction

Aging is associated with cognitive decline. In normal aging, this cognitive decline is related especially with learning ability (Bettio et al., 2017), memory (Bettio et al., 2017; Craik & Salthouse, 2011; Rizk-Jackson et al., 2013; Reichman et al., 2010; Sachdev et al., 2014; Salthouse, 2012), problem-solving activities and speed processing (Craik & Salthouse, 2011; Reichman et al., 2010; Salthouse, 2012).

Subjective cognitive impairment (SCI) is an earlier stage between normal aging and mild cognitive impairment (MCI). SCI is defined as self-reported cognitive impairment, before cognitive tests could detect a deficit (Cheng et al., 2017). SCI is more likely to progress to MCI (Snitz et al., 2018) and involves increased risk for underlying Alzheimer's Disease (AD) (Cheng et al., 2017).

MCI, especially is refers, to a decline in the ability to learn new information or recall stored information (Petersen & Morris, 2005) but not severe enough to cause significant impair in activities of daily living (ADLs) (Sanford, 2017). MCI, is a continuum between normal cognition and dementia, but it is not always a precursor to AD (Sanford, 2017). The annual conversion rate of MCI to AD ranges from 5.4% to 11.5% per

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person-year for community samples (Ward et al., 2013). There are different cognitive functions that could be affected in MCI, such as learning and memory, social functioning, language, visuospatial function, complex attention, and executive functioning (American Psychiatric Association, 2018; Sachdev et al., 2014).

Dementia is a disorder that is characterized by the progressive and persistent deterioration of cognitive function, enough to reduce a person's ability to perform ADLs and bring problems with behavior (Emmady & Tadi, 2022) and changes in mood (Nakane, 2011). This cognitive decline involves memory and at least one of the following domains: personality, praxis, abstract thinking, language, executive functioning, complex attention, and social and visuospatial skills (Buffington et al., 2013).

Cognitive stimulation (CS) could offer beneficial effects to cognitive reserve and dementia risk (Collins et al., 2021), so it is crucial to start it as early as possible (Woods et al., 2012). CS was defined by Clare and Woods (2004) as "activities that involve cognitive processing usually conducted in a social context and often in a group". It differs from other cognitive interventions such as cognitive training and cognitive rehabilitation. Cognitive training involves guided practice in a set of standard tasks to improve a specific cognitive function. Cognitive rehabilitation, uses an individualized approach aimed at improving performance in daily life to achieve pre-selected personal goals (Clare & Woods, 2004).

In this study, we aimed to evaluate the effects of one personalized and adapted program of CS in older adult participants in global cognition, neuropsychological constructs, ADLs, and the mood (anxiety and depression).

Activities of daily living: ADLs; Alzheimer's Disease: AD; Attention: A; Barthel Index: BI; Calculation: C; Cognitive stimulation: CS; Control group: CG; Fixation memory: Intervention group: FM; Lawton and Brody scale: L-B: IG; Instrumental ADLs: IADLs; Language: L; Level deterioration: LD; Mild cognitive impairment: MCI; Randomized controlled trial: Mini-Examen Cognoscitive: MEC-35; Mini-Mental State Examination: MMSE; Moderate deterioration: MD; No deterioration: ND; Temporal Orientation: TO; Praxis: P; RCT; Spatial orientation: Set-Test: ST:SO; Short-term memory: STM; Subjective cognitive impairment: SCI; Yesavage geriatric depression scale: GDS-15.

2. Materials and methods

2.1. Design

This randomized controlled trial (RCT) was conducted in a primary care center in the city of **ANONYMOUS** (northeastern Spain). The sample consisted of 337 participants who were patients in primary healthcare consultations and received normal medical and nursing care.

2.2. Participants

In order to detect the proportion of individuals having a certain level of cognitive impairment (as a four-category qualitative variable), the sample size was calculated for an expected proportion of 32%, with a 5% error and 95% confidence level. An algorithm implemented in WinEpi 2 was used for this calculation and an a reference older population of the 110,000 inhabitants (16% of the **ANONYMOUS** population) has been assumed (Vallejo et al., 2013). We obtained a sample size with a minimum of 335 individuals assuming normal distribution.

The inclusion criteria were: $\geq$ 65 years of age, receiving a score on the Spanish version of the Mini-Mental State Examination (MEC-35) ranging from 20 to 35 points, classified into 4 groups: 32–35 points for the no deterioration (ND) group, 28–31 points for the SCI group, 24–27 points for the level deterioration (LD) group, and 20–23 points for the moderate deterioration (MD) group. The exclusion criteria were institutionalization, deafness, blindness neuropsychiatric disorders, motor difficulties, and having received CS over the past 12 months.

2.3. Treatment allocation

For randomization, an opaque urn was used into which the participants' file numbers were placed and an anonymous person drew the selected numbers. The first author verified the inclusion criteria of the participants. A total of 367 candidates were evaluated. Following inclusion, the 337 participants were allocated into two groups: 160 participants in the intervention group (IG) and 177 participants in the control group (CG). Once the participants were distributed in the intervention and control groups, cut-off points were established with the Spanish version (MEC-35) of the Mini-Mental State Examination (MMSE) to make the subgroups (ND, SCI, LD and MD). In the ND group the participants had a score in the MEC-35 between 32 and 35 points; in the SCI group between 28 and 31 points; in the LD group between 24 and 27 points and in the MD group between 20 and 23 points. Thus, in the intervention group, the following subgroups were obtained: 50 participants in the ND group, 51 participants in the SCI group, 49 participants in the LD group and 10 participants in the MD group. Similarly, the control group had the following subgroups: 51 participants in the ND group, 49 participants in the SCI group, 59 participants in the LD group and 18 participants in the MD group.

The randomized controlled trial was single-blind, as the persons responsible for the assessments were blinded and different from those responsible for the intervention. A stratified randomization was carried out based on the scores obtained in the MEC-35. Scores of over 27 points on the (MEC-35) indicate an absence of cognitive impairment. However, scores of fewer than 27 points on the MEC-35 appear to indicate the presence of cognitive impairment (Calero & Navarro, 2006). The ND group consists of older adults with scores between 32 and 35 points on the MEC-35, and the SCI group had scores between 28 and 31. The cut-off of 31 points on the MEC-35, corresponding to a score of 25 on the MMSE, is based on the classification of (Friedman et al., 2012). The LD group had scores between 24 and 27 on the MEC-35, in accordance with the classification by Calero García and Navarro-González (2006) for individuals with MCI. Finally, the MD group had scores ranging from 20 to 23, in accordance with (Vinyoles Bargalló et al., 2002) in the presence of cognitive impairment. The ND group indicated normal cognition and the SCI group could indicate pre-symptomatic levels of cognitive impairment and decreased cognitive functioning (Rizk-Jackson et al., 2013). The LD group could indicate MCI and the MD group could indicate mild dementia.

A therapist who was independent from the study carried out the randomization.

2.4. Intervention

The intervention consists of in a CS program adapted to the cognitive level to the cognitive level of participants, evaluated by the MEC-35, and personalized according to occupational elements such as profession, interests, and roles. This program was designed by experimental occupational therapists. The participants performed 40 activities classified into 4 exercises for the following neuropsychological constructs: memory, orientation, language, praxis, gnosis, calculation, perception, logical reasoning, attention-concentration, and executive functions. Moreover, considering the results of the previous study, special interest was taken in reinforcing the activities of short-term memory, attention, and temporal orientation. This emphasis took place at the beginning of the session through blackboard activities (e.g., remembering what we had for breakfast, how we are dressed, what the weather is like, what street we are on, what the date is) and the clock (e.g., remembering what time it is), as well as in the specific exercises for these neuropsychological constructs, reviewing the activity results as a group reminder.

The CS-based intervention was administered in four groups (ND, SCI, LD, and MD) in 45-minute sessions, once a week for 10 weeks. Before carrying out the different activities, the participants received a theoretical explanation about the neuropsychological constructs that each

session would be working on.

The CG did not receive any intervention during the period of study.

2.5. Variables

The primary variable was the changes in the cognitive level as evaluated with the (MEC-35). The MEC-35 is one of the most widely used short cognitive tests for the study of cognitive capacities in primary care setting was. The MEC-35 evaluates eight cognitive functions: temporal and spatial orientation (10 points), fixation memory (3 points), attention (3 points), calculation (5 points), short-term memory (3 points), and language, and praxis (11 points). Its sensitivity is 89.8% and its specificity is 83.9% (Calero et al., 2000). This questionnaire was used to assess the global cognition and cognitive functions of temporal orientation (TO), spatial orientation (SO), fixation memory (FM), short-term memory (STM), calculation (C), attention (A), language (L), and praxis (P) (Lobo, 1999). Unlike the MMSE, the MEC-35 includes a three-digit series to repeat two similar items in reverse order. Subtraction is performed 3 by 3 from 30, instead of 7 by 7 from 100 (Folstein et al., 1975).

The secondary variables were semantic fluency evaluated with the Set-Test; the ADLs evaluated with the Barthel Index (BI) for basic ADLs (BADLs), and the Lawton and Brody scale (L-B) for instrumental ADLs (IADLs); and mood, evaluated with the Goldberg anxiety sub-scale for anxiety, and the Yesavage geriatric depression scale (15-point version for depressive symptoms).

The Set-Test (S-T) evaluated semantic fluency through four categories: colors, animals, fruits, and cities. Scores range from 0 to 40, with 0 being the minimum and 40 being the maximum score. The cut-off is 27 points, with a lower score indicating dementia. This questionnaire has a sensitivity of 79% and a specificity of 82% (Pascual Millán el al, 1990).

The B-I measured the independence in 10 BADLs. The maximum score is 100 points and scores $\geq$ 60 indicate mild dependence. The sensitivity of this index ranges from 76% (in the item "ambulation + stairs") to 99.8% (in the item "feeding") and its specificity ranges from 46% (in the item "defecation") to 97% (in the item "ambulation + stairs") in scores $\geq$ 90 points for fragility screening (Bernabeu-Wittel et al., 2019).

The L-B was the scale utilized to assess the autonomy in eight IADLs necessary to live independently. Scores range from 0 (dependent) to 8 (independent). The scale's sensitivity is 57% and its specificity is 82% when dependence is observed in three activities (Pfeffer et al., 1982).

The Goldberg anxiety sub-scale is a sub-scale of the Goldberg questionnaire, with nine dichotomous response items (yes/no responses) to evaluate the level of anxiety. An independent score is awarded for each scale, with one point for an affirmative answer. The cut-off value is $\geq$ 4 for the anxiety sub-scale, indicating "probable anxiety". This scale shows a specificity of 91% and a sensitivity of 86% (Goldberg et al., 1988).

The 15-point version of the Yesavage geriatric depression scale (GDS-15) evaluated the symptoms of depression, it is considered suitable for older adults living in a community. Scores range from 0 to 15, with a total score $>$ 5 interpreted as "probable depression". In older adults, with a cut-off of 5 points, sensitivity is 71.8% and specificity is 78.2% (Marc et al., 2008).

All outcome measures were assessed the start, post-intervention (short-term), 6 months (medium-term) after and 12 months after (long-term).

Besides these outcome variables, other socio-demographic characteristics, clinical characteristics, participants' lifestyle characteristics, contextual and environmental variables were collected using a structured interview.

The socio-demographic variables studied were age, gender, civil status, education level, physical occupational status, mental occupational status, nucleus of family coexistence, interests, roles, and values. Education level was divided into two subgroups (primary/secondary or higher). This is the most basic classification possible, given that this variable was not initially considered for the inference analysis of the results. The subdivision of physical occupational status and mental occupational status was made according to three levels: low, medium, and high for each, in accordance with the classification by Grotz et al. (2017). Nucleus of family coexistence was subdivided in two categories, living alone, and living with others family members. Interests (without interest, from 1 to 3 interests, and more than 3 interests) roles (no role, from 1 to 3 roles/more than 3 roles) and values (none; personal including health, happiness, peace, tranquility, family, love, and friendship) and social (including human values, culture, hope and religion, and independence) were based on a quantitative classification depending on the participants' responses, in according to Gary Kielhofner (2011). These values relate to the development of abilities and skills connected to daily routines found in occupational performance (Persson et al., 2001).

The clinical characteristics variables examined were grouped in no chronic pathology; 1, 2 or 3 chronic pathologies; or over 3 chronic pathologies. It was considered that the participants presented: high blood pressure, diabetes, hypercholesterolemia, obesity, heart disease, lung disease, peripheral vascular disease, visual disturbance, hearing impairment, cerebrovascular accident, alcoholism, anxiety treatment, and depression treatment (Calderón-larrañaga et al., 2017). For the category of "alcoholism", the participants were asked if they drank two or more drinks of alcohol per day. Moreover, all participants who were taking drugs (for depressive symptoms and for anxiety) were included in "depression treatment" or "anxiety treatment".

The lifestyle variables studied were smoking, and physical activity. We consider participants as smokers who smoked 10 or more cigarettes daily. Furthermore, the division of the subgroups was made in accordance with the level of physical activity (sedentary lifestyle, light, moderate and vigorous) for low, moderate, and high activity levels, according to the International Physical Activity Questionnaire (IPAQ). Participants who did not perform any physical activity were included in the "sedentary lifestyle" category (IPAQ, 2005).

The environmental variables related to the elimination of architectural barriers studied were technical aids in housing ($\leq$1 or $>$1). It was considered that the participants had: ramp to access their home, a lift, and a shower.

The blind evaluation process was performed by eight occupational therapists after receiving the corresponding training to ensure the homogeneous application of evaluation instruments.

2.6. Statistical analysis

The statistical analysis was performed with the IBM SPSS Statistics Package, v-22. The descriptive statistics are shown according to the nature of each variable. For the quantitative variables, the mean ($\bar{x}$), SD, and 95% confidence interval level were used for the population mean. For qualitative variables, the number of participants in each category (n) and the proportion of patients over the total (%) were considered. The Kolmogorov–Smirnov and Shapiro–Wilk tests were used to verify the normality of the quantitative variables. Most of them are non-normal distributions.

Pearson's chi-squared test was used to determine associations between qualitative variables. Differences between groups in the cognitive measurements were evaluated using the non-parametric Mann-Whitney U test for non-normal distributions and using Student's t-distribution for normal distributions. These differences were first, for the complete groups, and then with groups stratified by age.

In addition, for the quantitative variables and the IG, anon-parametric paired test was used to analyze the differences within groups at the different phases of the intervention (basal, post-intervention, 6 months, and 12 months).

Finally, the differences between groups were analyzed for the stratified data by age into two groups (at age $\leq$74, and at age $>$74).

2.7. Ethical considerations

This study was approved by **ANONYMOUS** and registered in ClinicalTrials.gov (identifies NCT03831061 and NCT04648670). All personal data protection regulations were respected. Participants were informed of the study objectives, and they signed a written informed consent form. The deontological norms recognized by the Declaration of Helsinki (52nd WMA General Assembly, Edinburgh, Scotland, October

Table 1
The participants' socio-demographic variables, clinical characteristics, participants' lifestyle, and environmental variables.

		Total ($n = 337$)	ND ($n = 101$)		SCI ($n = 100$)		LD ($n = 108$)		MD ($n = 28$)	
			IG ($n = 50$)	CG ($n = 51$)	IG ($n = 50$)	CG ($n = 50$)	IG ($n = 49$)	CG ($n = 59$)	IG ($n = 10$)	CG ($n = 18$)
Age (years) Mean (SD)		74 (6)	72.34 (0.80)	71.69 (0.77)	71.82 (0.72)	75.90 (0.80)	74.16 (0.80)	75.15 (0.78)	77.90 (1.75)	82.39 (1.10)
Participants' socio-demographic characteristics		**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Gender	Men	102 (30.3)	22 (21.8)	23 (22.8)	10 (10)	14 (14)	7 (6.5)	20 (18.5)	2 (7.1)	4 (14.3)
	Women	235 (69.7)	28 (27.7)	38 (27.7)	41 (41)	35 (35)	42 (38.9)	39 (36.1)	8 (28.6)	14 (50)
Civil Status	Single	17 (5)	1 (1)	1 (1)	2 (2)	2 (2)	3 (2.8)	6 (5.6)	1 (3.6)	1 (3.6)
	Widowed	7 (2.1)	7 (6.9)	11 (10.9)	15 (15)	14 (14)	15 (13.9)	12 (11.1)	0 (0.0)	0 (0.0)
	Married	227 (67.4)	39 (38.6)	39 (38.6)	33 (33)	33 (33)	30 (27.8)	39 (36.1)	6 (21.4)	8 (28.6)
	Separated	86 (26.5)	3 (3)	0 (0.0)	1 (1)	0 (0.0)	1 (0.9)	2 (1.9)	3 (10.7)	9 (32.1)
Education level	Primary	269 (79.8)	29 (28.7)	32 (31.7)	44 (44)	39 (39)	45 (41.7)	54 (50)	9 (32.1)	17 (60.7)
	Higher	68 (20.2)	21 (20.8)	19 (18.8)	7 (7)	10 (10)	4 (3.7)	5 (4.6)	1 (3.6)	1 (3.6)
Physical occupational status	Low	63 (18.7)	18 (17.8)	17 (16.8)	10 (10)	12 (12)	4 (3.7)	8 (7.4)	0 (0.0)	1 (3.6)
	Medium	145 (43)	18 (17.8)	20 (19.8)	17 (17)	11 (11)	31 (28.7)	29 (26.9)	8 (28.6)	14 (50)
	High	129 (38.3)	18 (17.8)	20 (19.8)	24 (24)	26 (26)	14 (13)	22 (20.4)	2 (7.1)	3 (10.7)
Mental occupational status	Low	205 (60.8)	14 (13.9)	26 (25.7)	36 (36)	30 (30)	34 (31.5)	44 (40.7)	5 (17.9)	16 (57.1)
	Medium	112 (33.2)	30 (29.7)	21 (20.8)	14 (14)	12 (12)	15 (13.9)	14 (13)	4 (14.3)	2 (7.1)
	High	20 (5.9)	6 (5.9)	4 (4)	1 (1)	7 (7)	0 (0.0)	1 (0.9)	1 (3.6)	0 (0.0)
Nucleus of family coexistence	Living alone	65 (19.3)	4 (4)	6 (6.1)	15 (14.6)	12 (11.5)	10 (9.4)	13 (12.3)	4 (13)	5 (17.4)
	Living with others	272 (80.7)	46 (45.6)	45 (44.5)	39 (38.6)	35 (35.4)	39 (35.8)	46 (42.5)	7 (26)	12 (43.4)
Interest	No interests	39 (11.6)	5 (5)	3 (3)	3 (3)	3 (3)	10 (9.3)	8 (7.4)	1 (3.6)	6 (21.4)
	1–3 interests	212 (62.9)	23 (22.8)	34 (33.7)	35 (35)	28 (28)	29 (26.9)	45 (41.7)	7 (25)	11 (39.3)
	> 3 interests	86 (25.5)	22 (21.8)	14 (13.9)	13 (13)	18 (18)	10 (9.3)	6 (5.6)	2 (7.1)	1 (3.6)
Roles	No role	4 (1.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1)	0 (0.0)	2 (1.9)	0 (0.0)	1 (3.6)
	1- 3 roles	319 (94.7)	48 (47.5)	49 (48.5)	50 (50)	47 (47)	47 (43.5)	53 (49.1)	9 (32.1)	16 (57.1)
	3 roles	14 (4.2)	2 (2)	2 (2)	1 (1)	1 (1)	2 (1.9)	4 (3.7)	1 (3.6)	1 (3.6)

		Total ($n = 337$)	ND ($n = 101$)		SCI ($n = 100$)		LD ($n = 108$)		MD ($n = 28$)	
			IG ($n = 50$)	CG ($n = 51$)	IG ($n = 50$)	CG ($n = 50$)	IG ($n = 49$)	CG ($n = 59$)	IG ($n = 10$)	CG ($n = 18$)
Values	None	9 (2.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.9)	3 (2.8)	0 (0.0)	4 (14.3)
	Personal+ Human	299 (88.7)	47 (46.5)	44 (43.6)	44 (44)	45 (45)	43 (39.8)	54 (50)	10 (37.5)	14 (50)
	Social	29 (8.6)	3 (3)	7 (6.9)	7 (7)	4 (4)	4 (3.7)	2 (1.9)	0 (0.0)	0 (0.0)
Participants' clinical characteristics										
No Chronic Pathology		8 (2.4)	3 (2)	1 (1)	2 (2)	2 (2)	1 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)
1–3 Chronic Pathologies		184 (54.6)	23 (22.8)	31 (30.7)	29 (29)	29 (29)	27 (25.1)	33 (30.6)	5 (17.8)	7 (24.9)
> 3 Chronic Pathologies		145 (43)	25 (24.8)	19 (18.8)	20 (20)	18 (18)	21 (19.4)	26 (24.1)	5 (17.9)	11 (39.3)
Participants' lifestyle										
Physical activity	Sedentary lifestyle	32 (9.5)	0 (0.0)	2 (2)	2 (2)	6 (6)	9 (8.3)	6 (5.6)	0 (0.0)	7 (25)
	Light	34 (10.1)	5 (5)	4 (4)	1 (1)	0 (0.0)	10 (9.3)	9 (8.3)	3 (10.7)	2 (7.1)
	Moderate	240 (71.2)	40 (39.6)	39 (38.6)	43 (43)	43 (43)	23 (21.3)	40 (37)	5 (17.9)	7 (25)
	Vigorous	31 (9.2)	5 (5)	6 (5.9)	5 (5)	0 (0.0)	7 (6.5)	4 (3.7)	2 (7.1)	2 (7.1)
Smoking	No	328 (97.3)	48 (47.5)	49 (48.5)	51 (51)	47 (47)	48 (44.4)	57 (52.8)	10 (35.7)	18 (64.3)
	Yes	9 (2.7)	2 (2)	2 (2)	0 (0.0)	2 (2)	1 (0.9)	2 (1.9)	0 (0.0)	0 (0.0)
Participants' environmental variables										
Ramp use	No	156 (46.3)	30 (29.7)	21 (20.8)	33 (33)	22 (22)	28 (25.9)	33 (30.6)	6 (21.4)	8 (28.6)
	Yes	181 (53.7)	20 (19.8)	30 (29.7)	18 (18)	27 (27)	21 (19.4)	26 (24.1)	A4 (14.3)	10 (35.7)
Lift use	No	43 (12.8)	7 (6.9)	3 (3)	4 (4)	8 (8)	7 (6.5)	10 (9.3)	1 (3.6)	3 (10.7)
	Yes	294 (87.2)	43 (42.6)	38 (47.5)	47 (47)	41 (41)	42 (38.9)	49 (45.4)	9 (32.1)	15 (53.6)
Have shower at home	No	207 (61.4)	13 (12.9)	13 (12.9)	21 (21)	24 (24)	20 (18.5)	30 (27.8)	5 (17.9)	4 (14.3)
	Yes	130 (38.6)	37 (36.6)	38 (37.6)	30 (30)	25 (25)	29 (26.9)	29 (26.9)	5 (17.9)	14 (50)

CG: Control group; IG: Intervention group; LD: Level deterioration group; MD: Moderation deterioration group; ND: No deterioration group; SCI: Subtle cognitive impairment group.

20,020) and good clinical practice norms were followed, and the study complied with current legislation. The manuscript followed the CONSORT 2010 recommended guidelines (Schulz et al., 2010).

3. Results

This study included 337 older adults with MEC-35 scores between 20 and 35 points. Table 1 shows the socio-demographic characteristics, clinical characteristics, participants' lifestyles, and contextual and environmental variables; no observed statistically significant differences were observed. The mean age was 74, with SD of 6; and by groups: 72.02 (0.79) for the ND group; 73.86 (0.76) for the SCI group; 74.66 (0.79) for the LD group, and 80.15 (1.43) for the MD group. The proportion of women is higher in the four groups.

Of the total number of participants, 160 belonged to the IG and 177 belonged to the CG; 101 to the ND group (50 IG, 51 CG); 100 to the SCI group (50 IG, 50 CG) 108 to the LD group (49 IG, 59 CG) and 28 to the MD group (10 IG, 18 CG) (See the flowchart in Fig. 1).

The baseline scores obtained in the different variables can be found in the supplementary material (Figures 1S and 2S). Table 2 presents the differences between groups at basal, post-intervention, 6 months, and 12 months in the different outcome variables by groups.

For the variable measuring global cognition, the MEC-35, statistically significant differences were observed in favor of IG in the following groups: 1) the ND group: post-intervention ($p = 0.002$) with a mean difference of 1.07 points, at 6 months ($p = 0.031$) with a mean difference

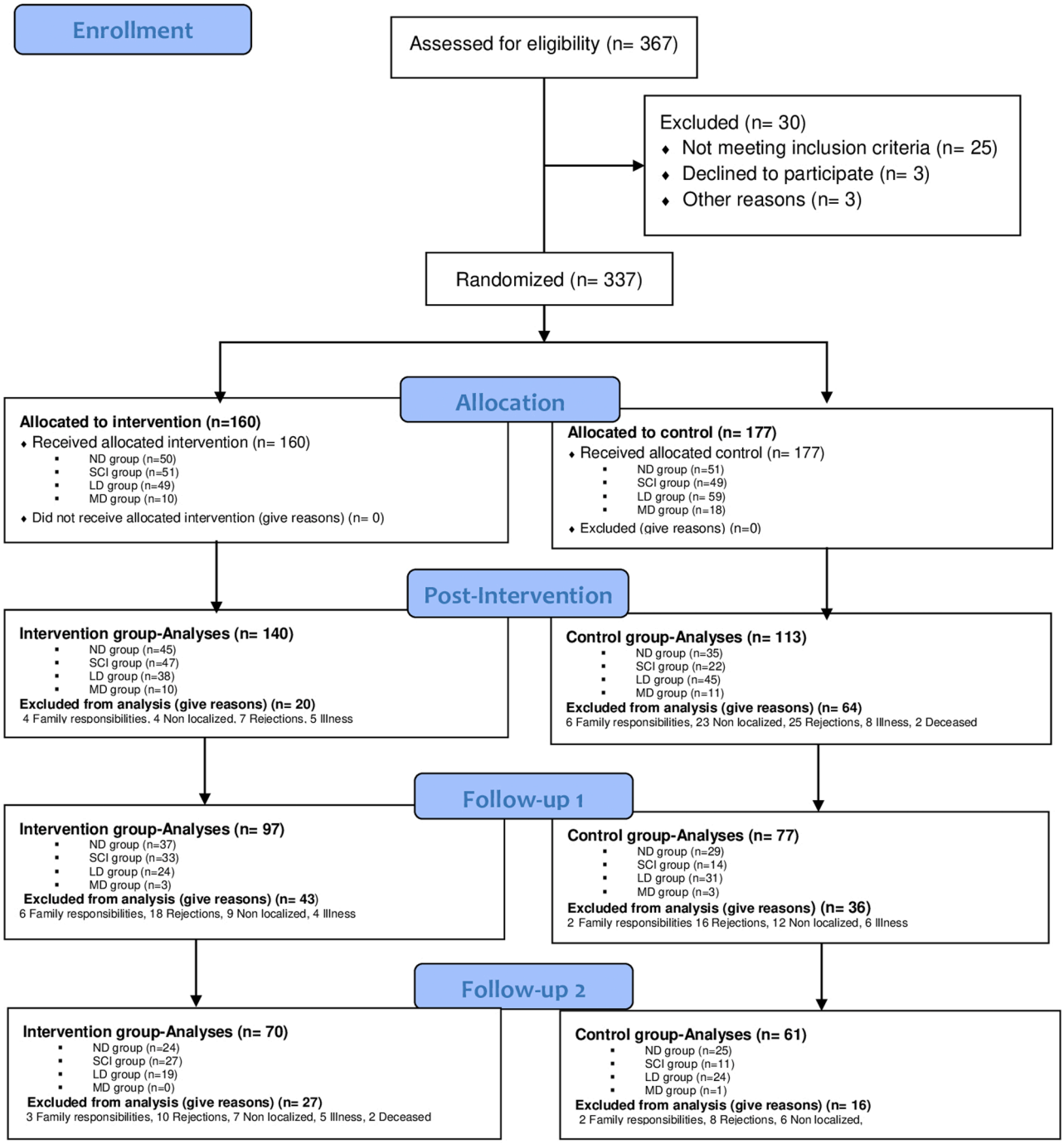

Fig. 1. Consort 2010. Flow diagram.

Table 2
Differences between groups at basal, post-intervention, 6 and 12 months in the different outcome variables by groups.

		Basal			*Post-Intervention*				*6 months*				*12 months*			
	Variables	*IG (n = 50) Mean (Std)*	*CG (n = 51) Mean (Std)*	*p-value*	*IG (n = 45) Mean (Std)*	*CG (n = 35) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 37) Mean (Std)*	*CG (n = 29) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 24) Mean (Std)*	*CG (n = 25) Mean (Std)*	*Dif. Mean*	*p-value*
	MEC-35	33.14 (1.010)	33.27 (1.027)	0.493	33.47 (1.408)	32.40 (1.594)	1.07	**0.002**	33.70 (1.561)	32.72 (1.869)	1.02	**0.031**	33.83 (1.685)	32.56 (1.557)	0.27	**0.008**
	Cognitive aspects															
NO DETERIORATION GROUP	*T Orientation*	4.80 (0.495)	4.90 (0.300)	0.326	4.80 (0.457)	4.74 (0.505)	0.06	0.577	4.92 (0.277)	4.59 (0.682)	0.33	**0.014**	4.83 (0.482)	4.32 (0.900)	0.51	**0.015**
	S Orientation	4.82 (0.438)	4.94 (0.238)	0.101	4.87 (0.344)	4.94 (0.236)	0.07	0.263	4.92 (0.277)	4.93 (0.258)	0.01	0.855	4.96 (0.204)	4.92 (0.277)	0.04	0.580
	S-T Memory	2.34 (0.717)	2.35 (0.844)	0.636	2.58 (0.657)	2.23 (0.973)	0.35	0.139	2.68 (0.669)	2.45 (0.910)	0.23	0.309	2.75 (0.532)	2.48 (0.823)	0.27	0.216
	F Memory	3 (0.0)	3 (0.0)	–	3 (0.0)	3 (0.0)	0	–	3 (0.0)	3 (0.0)	0	–	3 (0.0)	3 (0.0)	0	–
	Calculation	4.94 (0.240)	4.84 (0.418)	0.189	4.87 (0.457)	4.89 (0.323)	-0.02	0.765	4.84 (0.442)	4.79 (0.620)	0.05	0.957	4.83 (0.381)	4.88 (0.332)	0.02	0.644
	Attention	2.62 (0.830)	2.71 (0.756)	0.566	2.64 (0.773)	2.63 (0.843)	0.01	0.988	2.76 (0.723)	2.55 (1.021)	0.21	0.410	2.68 (0.761)	2.67 (0.748)	0.01	0.950
	Language	5.76 (0.476)	5.78 (0.415)	0.917	5.91 (0.288)	5.83 (0.453)	0.09	0.431	5.89 (0.516)	5.90 (0.310)	-0.01	0.481		5.84 (0.374)		**–**
	Praxis	4.86 (0.405)	4.75 (0.440)	0.097	4.80 (0.405)	4.14 (0.733)	0.66	**<0.001**	4.70 (0.520)	4.52 (0.634)	0.18	0.204	4.79 (0.415)	4.44 (0.583)	0.35	**0.022**
	Set-Test	39.14 (1.565)	38.96 (1.708)	0.833	39.04 (1.551)	39.29 (1.759)	0,25	0.357	39.16 (1.537)	39.41 (1.524)	-0.25	0.303	39.00 (0.278)	39.52 (1.122)	-0.52	0.690
	Barthel	98.20 (4.375)	97.16 (6.265)	0.285	98.22 (4.150)	98.43 (4.816)	-0.21	0.533	98.51 (3.885)	98.97 (2.796)	-0.46	0.756	99.17 (2.408)	99.20 (2.363)	-0.03	0.958
	Lawton	7.38 (1.408)	7.22 (1.254)	0.694	7.22 (1.126)	6.89 (1.409)	0.33	0.442	7.24 (1.116)	7.34 (1.143)	-0.10	0.455	7.63 (0.770)	7.32 (1.069)	0.31	0.414
	Goldberg	3.010 (2.484)	2.824 (2.576)	0.789	3.34 (2.131)	3.20 (2.501)	0.14	0.781	2.51 (2.448)	2.33 (2.076)	0.18	0.953	2.23 (1.950)	1.96 (1.541)	0.27	0.594
	GDS-15	2.210 (2.131)	2.716 (2.492)	0.356	2.02 (2.286)	2.49 (3.170)	0.47	0.450	1.55 (2.217)	1.90 (2.289)	0.35	0.359	1.21 (1.763)	1.46 (1.520)	0.25	5.95

		Basal			*Post-Intervention*				*6 months*				*12 months*			
	Variables	*IG (n = 51) Mean (Std)*	*CG (n = 49) Mean (Std)*	*p-value*	*IG (n = 47) Mean (Std)*	*CG (n = 22) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 33) Mean (Std)*	*CG (n = 14) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 27) Mean (Std)*	*CG (n = 11) Mean (Std)*	*Dif. Mean*	*p-value*
	MEC-35	29.51 (1.007)	29.39 (1.047)	0.545	31.36 (2.079)	29.59 (2.789)	1.77	**0.004**	31.64 (2.219)	30.31 (2.016)	1.33	**0.036**	32.12 (2.088)	30.09 (2.071)	2.03	**0.017**
	Cognitive aspects															
SUBTLE COGNITIVE IMPAIRMET GROUP	*T Orientation*	4.65 (0.716)	4.47 (0.739)	0.136	4.60 (0.798)	4.32 (1.359)	0.18	0.628	4.85 (0.445)	4 (1.225)	0.85	**0.004**	4.52 (1.046)	4.09 (0.831)	0.43	0.066
	S Orientation	4.84 (0.267)	4.76 (0.522)	0.488	4.83 (0.481)	4.59 (0.590)	0.24	**0.031**	4.85 (0.364)	4.85 (0.376)	0	0.544	4.88 (0.440)	4.64 (0.924)	0.24	0.612
	S-T Memory	1.71 (0.879)	1.49 (1.063)	0.323	2.21 (0.750)	1.64 (1.136)	0.57	**0.047**	2.42 (0.867)	2.15 (1.068)	0.27	0.274	2.56 (0.651)	1.73 (1.272)	0.83	0.101
	F Memory	3 (0.0)	3 (0.0)	–	3 (0.0)	2.95 (0.213)	0.05	–	3 (0.0)	3 (0.0)	0	–	3 (0.0)	3 (0.0)	0	–
	Calculation	4.47 (0.857)	4.61 (0.492)	0.913	4.53 (0.830)	4.55 (0.739)	-0.02	0.962	4.61 (0.827)	4.62 (0.650)	-0.01	0.929	4.48 (0.872)	4.64 (0.924)	-0.16	0.525

(*continued on next page*)

Table 2 (*continued*)

	Variables	*Basal*			*Post-Intervention*				*6 months*				*12 months*			
		IG (n = 51) *Mean (Std)*	*CG (n = 49)* *Mean (Std)*	*p-value*	*IG (n = 47)* *Mean (Std)*	*CG (n = 22)* *Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 33)* *Mean (Std)*	*CG (n = 14)* *Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 27)* *Mean (Std)*	*CG (n = 11)* *Mean (Std)*	*Dif. Mean*	*p-value*
	Attention	1.31 (1.122)	1.37 (1.167)	0.873	1.81 (1.227)	2.09 (1.269)	0.28	0.413	2.03 (1.212)	1.92 (1.115)	0.11	0.692	1.92 (1.187)	1.55 (1.214)	0.37	0.485
	Language	5.24 (0.710)	5.27 (0.861)	0.578	5.81 (0.495)	5.32 (0.799)	0.49	**0.005**	5.55 (0.711)	5.54 (0.776)	0.01	0.713	5.96 (0.200)	5.82 (0.405)	0.14	0.505
	Praxis	4.29 (0.672)	4.43 (0.736)	0.155	4.53 (0.584)	4.14 (0.774)	0.39	0.038	4.33 (0.736)	4.23 (0.599)	0.10	0.393	4.80 (0.408)	4.64 (0.505)	0.16	0.634
	Set-Test	96.12 (6.476)	37.69 (2.859)	0.853	38.89 (2.088)	38.05 (3.093)	0.84	0.333	39.15 (1.955)	38.23 (2.242)	0.92	0.081	39.20 (1.936)	39.73 (0.467)	0.53	0.775
	Barthel	98.28 (3.553)	96.12 (6.476)	0.127	97.55 (6.331)	96.59 (5.646)	0.96	0.213	97.15 (5.867)	93.85 (8.454)	3.30	0.324	98 (5.204)	95 (5.916)	3	0.190
	Lawton	7.40 (1.233)	7.22 (1.195)	0.305	7.61 (0.794)	6.86 (1.521)	0.75	**0.009**	7.55 (0.905)	6.54 (2.295)	1.01	0.464	7.56 (0.768)	6.73 (2.102)	0.83	0.446
	Goldberg	2.81 (2.687)	2.43 (2.257)	0.555	2.81 (2.245)	3.75 (1.696)	0.94	**0.006**	3.14 (2.356)	3.27 (2.297)	0.13	0.607	2.66 (2.375)	3.82 (2.676)	1.16	0.216
	GDS-15	2.90 (2.581)	2.918 (2.987)	0.627	2.60 (5.670)	3.57 (3.378)	0.97	0.233	2.73 (2.024)	3.04 (3.455)	0.31	0.805	1.90 (1.926)	3.55 (3.213)	1.65	0.064
	MEC-35	25.98 (0.989)	25.63 (1.032)	0.072	29.12 (2.705)	26.64 (4.075)	2.48	**0.001**	29.83 (2.632)	27.16 (4.026)	2.67	**0.005**	30.05 (2.527)	27.54 (4.075)	2.51	**0.024**
	Cognitive aspects															
LEVEL DETERIORATION GROUP	*T Orientation*	3.96 (1.020)	3.81 (1.152)	0.544	4.63 (0.633)	3.80 (1.286)	0.83	**<0.001**	4.46 (0.932)	3.81 (1.352)	0.65	**0.037**	4.42 (0.769)	3.83 (1.239)	0.59	0.099
	S Orientation	4.20 (0.790)	4.47 (0.653)	0.071	4.50 (0.726)	4.48 (0.876)	0.02	0.787	4.88 (0.338)	4.39 (0.761)	0.49	**0.007**	4.68 (0.582)	4.63 (0.647)	0.05	0.803
	S-T Memory	1.08 (1.057)	0.75 (0.843)	0.114	1.58 (1.056)	1.34 (1.119)	0.24	0.429	2.33 (0.816)	1.58 (1.057)	0.75	**0.008**	2.58 (0.507)	1.63 (1.209)	0.95	**0.009**
	F Memory	3 (0.0)	3 (0.0)	–	3 (0.0)	3 (0.0)	0	–	3 (0.0)	3 (0.0)	0	–	3 (0.0)	3 (0.0)	0	
	Calculation	3.67 (1.345)	3.76 (1.304)	0.740	4.24 (1.076)	3.64 (1.699)	2.40	0.113	4.13 (1.191)	3.32 (1.423)	0.81	**0.015**	4.11 (0.994)	3.83 (1.274)	0.28	0.449
	Attention	1.04 (1.098)	1.12 (1.052)	0.564	1.37 (1.195)	1.48 (1.067)	0.11	0.422	1.33 (1.239)	1.77 (1.087)	-0.44	0.136	1.42 (1.216)	1.42 (1.248)	0	0.991
	Language	4.84 (0.874)	4.56 (0.952)	0.128	5.24 (0.943)	4.73 (1.042)	0.51	**0.015**	5.29 (0.806)	4.97 (1.016)	0.32	0.263	5.32 (0.885)	4.67 (0.868)	0.65	**0.020**
	Praxis	4.18 (0.808)	4.10 (0.736)	0.446	4.58 (0.642)	4.16 (0.963)	0.42	**0.016**	4.38 (0.711)	4.35 (0.798)	0.03	0.955	4.47 (0.612)	4.46 (0.658)	0.01	0.999
	Set-Test	37.18 (3.644)	34.37 (5.119)	0.002	37.92 (3.035)	36.11 (5.306)	1.81	**0.043**	38.42 (2.535)	35.23 (5.914)	3.19	**0.024**	39.05 (1.870)	37.13 (3.687)	1.92	**0.035**
	Barthel	96.71 (7.971)	96.19 (6.252)	0.957	96.45 (6.463)	95.40 (7.111)	1.05	0.307	95.63 (9.006)	94.95 (8.490)	0.68	0.534	95.26 (9.048)	94.79 (7.144)	0.47	0.461
	Lawton	7.27 (1.319)	6.54 (1.977)	0.015	7.24 (1.261)	6.36 (1.954)	0.88	**0.021**	7.42 (1.213)	6.87 (1.607)	0.55	**0.041**	7.37 (1.342)	7.25 (0.847)	0.12	0.188
	Goldberg	3.35 (2.343)	2.71 (2.434)	0.216	3.08 (2.350)	2.98 (2.262)	-0.10	0.869	2.60 (2.016)	2.89 (2.445)	0.29	0.648	3.11 (2.390)	2.94 (2.771)	0.17	0.835
	GDS-15	3.06 (2.631)	3.26 (2.866)	0.892	2.92 (3.107)	3.64 (3.496)	0.72	0.423	2.15 (1.879)	3.29 (3.748)	1.14	0.146	2.66 (2.490)	3.96 (4.048)	1.30	0.227

		Basal			Post-Intervention				6 months		
	Variables	IG (n = 10) Mean (Std)	CG (n = 18) Mean (Std)	p-value	IG (n = 10) Mean (Std)	CG (n = 11) Mean (Std)	Dif. Mean	p-value	IG (n = 3) Mean (Std)	CG (n = 3) Mean (Std)	Dif. Mean
	MEC-35	22.20 (1.033)	21.72 (1.127)	0.279	24 (3.162)	24.73 (4.245)	-0.73	0.664	22.67 (4.726)	24.33 (1.528)	-1.66
	Cognitive aspects										
MODERATE DETERIORATION GROUP DETERIORATION GROUP	*T Orientation*	2.70 (1.494)	2.83 (1.200)	0.798	3 (1.826)	3.82 (0.982)	-0.82	0.229	2.67 (2.517)	4 (1.000)	-1.33
	S Orientation	4.30 (0.949)	4.28 (0.895)	0.951	3.70 (1.160)	4.36 (1.027)	-0.66	0.180	4 (1.000)	4.67 (0.577)	-0.67
	S-T Memory	0.20 (0.632)	0.44 (0.511)	0.112	1.70 (2.830)	1.27 (1.191)	0.43	0.652	1.33 (1.155)	1 (1.000)	0.33
	F Memory	3 (0.0)	3 (0.0)	–	3 (0.0)	3 (0.0)	0	–	3 (0.0)	3 (0.0)	0
	Calculation	3 (1.633)	2.22 (1.114)	0.146	3.50 (1.509)	2.27 (1.618)	1.23	0.089	1.33 (1.528)	1.33 (0.577)	0
	Attention	0.90 (1.197)	0.89 (0.900)	0.675	1.60 (1.075)	1.91 (1.221)	0.31	0.547	1.67 (1.155)	1.67 (1.155)	0
	Language	4.30 (1.160)	4.33 (1.188)	0.943	4.60 (0.966)	4.36 (0.924)	0.24	0.573	5 (1.000)	4.33 (0.577)	0.67
	Praxis	3.80 (0.789)	3.72 (0.826)	0.810	3.40 (1.350)	3.91 (1.136)	0.51	0.360	3.67 (0.577)	4.33 (1.528)	0.66
	Set-Test	30.30 (4.473)	31.83 (5.732)	0.472	30.30 (5.599)	33.64 (4.632)	3.34	0.152	26.33 (9.713)	36 (3.464)	-9.67
	Barthel	97 (4.830)	89.72 (7.371)	0.010	95 (4.714)	86.82 (12.505)	8.18	0.065	96.67 (5.774)	85 (15.000)	11.67
	Lawton	6.40 (1.713)	6.33 (1.940)	0.928	6.80 (2.098)	5.82 (1.722)	0.98	0.254	4.33 (3.215)	5.33 (1.528)	-1
	Goldberg	2.75 (2.595)	3.19 (2.568)	0.666	1.60 (1.630)	4.55 (2.505)	2.95	**0.005**	1.83 (2.363)	3.67 (3.055)	1.84
	GDS-15	2.85 (2.868)	5.17 (4.263)	0.138	1.90 (2.079)	4.23 (3.524)	2.33	0.080	0.67 (0.764)	8 (2.784)	7.33

Dif Mean: Difference of Mean; F: Fixation; Goldberg: Goldberg anxiety sub-scale; GDS-15: Yesavage geriatric depression scale, 15-point version; S: Spatial; S-T: Short-term; MEC-35: Spanish version of the Mini-Mental State Examination.

of 1.02 points, and at 12 months ($p = 0.008$) with a mean difference of 0.27 points; 2) the SCI group: post-intervention ($p = 0.004$) with a mean difference of 1.77 points, at 6 months ($p = 0.036$) with a mean difference of 1.33 points, and at 12 months ($p = 0.017$) with a mean difference of 2.03 points; and 3) the LD group: post-intervention ($p = 0.001$) with a mean difference of 2.48 points, at 6 months ($p = 0.005$) with a mean difference of 2.67 points, and at 12 months ($p = 0.024$) with a mean difference of 2.51 points.

For the IG and CG, the differences in the MEC-35 from one phase to the next are shown (Figure 3S). For the IG, in the ND, SCI, and LD groups, all these differences are positive.

Analyzing separately the eight components of the MEC-35, we observed statistically significant differences in favor of the IG for: 1) ND group: in P post-intervention ($p < 0.001$) with a mean difference of 0.66 points and at 12 months ($p = 0.022$) with a mean difference of 0.35 points; in TO at 6 months and 12 months ($p = 0.014$ and $p = 0.0015$ respectively) with a mean difference of 0.33 and 0.51 points respectively; 2) SCI group: in SO post-intervention ($p = 0.031$) with a mean difference of 0.24 points, in STM post-intervention ($p = 0.047$) with a mean difference of 0.57 points, in L post-intervention ($p = 0.005$) with a mean difference of 0.49 points, and in TO at 6 months ($p = 0.004$) with a mean difference of 0.85 points; and 3) LD group: in TO post-intervention and at 6 months ($p = <0.001$ and $p = 0.037$ respectively) with a mean difference of 0.83 and 0.65 points, in L in the post-intervention, and at 12 months ($p = 0.015$ and $p = 0.020$) with a mean difference of 0.51 and 0.65 points, in P in the post-intervention ($p = 0.016$) with a mean difference of 0.42 points, in SO at 6 months ($p = 0.007$) with a mean difference of 0.49 points, in STM at 6 and 12 months ($p = 0.008$ and $p = 0.009$ respectively) with a mean difference of 0.75 and 0.95 points and in calculation at 6 months ($p = 0.015$) with a mean difference of 0.81 points.

For the semantic fluency variable, evaluated with the S-T, statistically significant differences were found in the LD group in the three evaluations carried out after intervention ($p = 0.043$ in the post-intervention, $p = 0.024$ at 6 months and $p = 0.035$ at 12 months) with a mean difference of 1.81, 3.19, and 1.92 points respectively.

Analyzing the variables referring to ADLs, statistically significant differences can be seen in IADLS in the SCI group post-intervention ($p = 0.009$) in the L-B with a mean difference of 0.75 points; in the LD group in the L-B post-intervention ($p = 0.021$) with a mean difference of 0.88 points and at 6 months ($p = 0.041$) with a mean difference of 0.55 points.

For variables related to mood, we observed statistically significant differences in the SCI group and in the MD group in anxiety measured by the Goldberg sub-scale post-intervention ($p = 0.006$ and $p = 0.005$ respectively) with a mean difference of 0.94 and 2.95 points.

The average of the quantitative variables (cognitive functions, AVDs, and mood) post-intervention, at 6 months and at 12 months for all groups is presented in the supplementary material (Figures 4S, 5S and 6S). The most representative changes can be observed in the SCI group post-intervention and in the SCI group and the MD group at 6 months in the BI. Although we did not find significant differences in the BI, it could indicate the inflection point at which difficulties in the performance of ADLs begin to be seen in the continuum between normal cognition and cognitive impairment.

Table 3 presents the differences within groups for the IG group along the different phases (basal, post-intervention, 6 months, and 12 months) and for the different outcome variables.

For the MEC-35, statistically significant differences were observed in the ND, SCI, and LD groups, with $p = 0.004$, $p<0.001$ and $p<0.001$ respectively. For the STM variable, we observed statistically significant differences in the ND, SCI, and the LD groups, with $p = 0.010$, $p = 0.010$ and $p<0.001$ respectively. In language, statistically significant differences were found in the ND and SCI groups with $p = 0.012$ and $p<0.001$ respectively. Statistically significant differences in A and P were found for the SCI group with $p = 0.006$ and $p = 0.005$ respectively. For the LD group, statistically significant differences were found in TO and SO, with $p = 0.002$ and $p = 0.001$ respectively.

Finally, the LD group shows statistically significant differences in the S-T, with $p<0.001$, and the ND group found statistically significant differences in the Goldberg sub-scale, with $p = 0.037$.

Stratifying by age group ($\leq$ 74 years and $>$ 75 years), significant differences we are observed in the three groups in which this analysis could be performed. In the MD group it was not possible to stratify by age because the sample was very small and there were no participants $\leq$ 74 years in the CG. The following significant differences were found in the other three groups (ND, SCI, and LD) (Table 4):

1) ND group participants with $\leq$ 74 years in the MEC-35 post-intervention and at 12 months ($p = 0.011$ and $p = 0.017$ respectively) with a mean difference of 0.93 and 1.25 points; in TO at 6 months ($p = 0.036$) with a mean difference of 0.29 points; in STM at 12 months ($p = 0.036$) with a mean difference of 0.29 points, and in P post-intervention and at 12 months ($p = 0.010$ and $p = 0.027$) with a mean of difference of 0.42 and 0.43 points.
2) ND group participants with $>$ 75 years in the MEC-35 post-intervention and at 12 months ($p = 0.019$ and $p = 0.049$ respectively) with a mean difference of 0.93 and 1.25 points; and in P in the post-intervention and at 12 months ($p=<0.001$ and $p = 0.032$) with a mean of difference of 1.11 and 0.50 points. The MEC-35 at 6 months is very close to the significance level ($p = 0.054$)
3) SCI group participants with $>$ 75 years in TO at 6 months ($p = 0.017$) with a mean difference of 1.50 points; in SO post-intervention ($p = 0.026$) with a mean difference of 0.52 points, and in GDS-15 at 12 months ($p = 0.039$) with a mean difference of 3.44 points.
4) LD group participants with $\leq$ 74 years in the MEC-35 post-intervention and at 6 months ($p = 0.032$ and $p = 0.041$ respectively) with a mean difference of 2.17 and 3.07 points; in TO, post-intervention ($p = 0.010$) with a mean difference of 0.66 points, and in STM at 6 months ($p = 0.018$) with a mean difference of 0.83 points. LB at 6 months is very close to the significance level ($p = 0.051$).
5) LD group participants with $>$ 75 years in TO, post-intervention and at 6 months ($p = 0.005$ and $p = 0.037$ respectively) with a mean difference of 0.86 and 0.77 points respectively, in STM at 12 months ($p = 0.045$) with a mean difference of 1,18 points, and in C at 12 months ($p = 0.041$) with a mean difference of 1.10 points. The S-T at 6 months is very close to the significance level ($p = 0.052$).

4. Discussion

This RCT showed that a program adapted according to the cognitive level of the participants and a personalized CS improved according to time (short, medium. and long terms) and to cognitive level in terms of global cognitive function and, different cognitive functions such as (TO, SO, A, STM, C, L, and P), verbal fluency, and levels of anxiety.

Regarding ***global cognition***, the personalized and adapted program of CS achieved statistical significance between and within group improvements in the ND, SCI, and LD groups, post-intervention, and at 6 months, and 12 months. Other authors found similar results between groups in participants with normal cognition (Polito et al., 2015; Schultheisz et al., 2018) and within group (P. Gamito et al., 2020; Park et al., 2019; Tarnanas et al., 2014); in participants with MCI bet-ween groups (Polito et al., 2015; Tsai et al., 2019), and within group (Llanero Luque et al., 2011), also including older adults from MCI to mild-to-moderate dementia bet-ween groups (J Alves et al., 2014) and within group (Kim et al., 2017) post-intervention; as well as an effect of interaction between session and group in participants with MCI (Moro et al., 2015) post-intervention and 6 months later. All these programs assess global cognition with other instruments [The Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA) and Alzheimer Disease Assessment Scale-Cognitive Subscale (ADAS-Cog)]; some of them in younger participants (Polito et al., 2015; Tarnanas et al.,

Table 3
Differences within IG group at basal, post-intervention, 6 and 12 months in the different outcome variables by groups.

	Variables	*Basal* *Mean* *(Std)*	*Post-I* *Mean* *(Std)*	*6 months* *Mean* *(Std)*	*12 months* *Mean* *(Std)*	*p-value*
	MEC-35	33.14 (1.010)	33.47 (1.408)	33.70 (1.561)	33.83 (1.685)	**0.004***
	Cognitive aspects					
NO DETERIORATION GROUP	*T Orientation*	4.80 (0.495)	4.80 (0.457)	4.92 (0.277)	4.83 (0.482)	0.793
	S Orientation	4.82 (0.438)	4.87 (0.344)	4.92 (0.277)	4.96 (0.204)	0.429
	S-T Memory	2.34 (0.717)	2.58 (0.657)	2.68 (0.669)	2.75 (0.532)	**0.010***
	F Memory	3 (0.000)	3 (0.000)	3 (0.000)	3 (0.000)	–
	Calculation	4.94 (0.240)	4.87 (0.457)	4.84 (0.442)	4.83 (0.381)	0.356
	Attention	2.62 (0.830)	2.64 (0.773)	2.76 (0.723)	2.68 (0.761)	0.957
	Language	5.76 (0.476)	5.91 (0.288)	5.89 (0.516)		**0.012***
	Praxis	4.86 (0.405)	4.80 (0.405)	4.70 (0.520)	4.79 (0.415)	0.207
	Set-Test	39.14 (1.565)	39.04 (1.551)	39.16 (1.537)	39.00 (0.278)	0.413
	Barthel	98.20 (4.375)	98.22 (4.150)	98.51 (3.885)	99.17 (2.408)	0.216
	Lawton	7.38 (1.408)	7.22 (1.126)	7.24 (1.116)	7.63 (0.770)	0.096
	Goldberg	3.010 (2.484)	3.34 (2.131)	2.51 (2.448)	2.23 (1.950)	**0.037***
	GDS-15	2.210 (2.131)	2.02 (2.286)	1.55 (2.217)	1.21(1.763)	0.061
	MEC-35	29.51 (1.007)	31.36 (2.079)	31.64 (2.219)	32.1 (2.088)	**<0.001****
	Cognitive aspects					
SUBTLE COGNITIVE IMPAIRMET GROUP	*T Orientation*	4.65 (0.716)	4.60 (0.798)	4.85 (0.445)	4.52 (1.046)	0.343
	S Orientation	4.84 (0.267)	4.83 (0.481)	4.85 (0.364)	4.88 (0.440)	0.500
	S-T Memory	1.71 (0.879)	2.21 (0.750)	2.42 (0.867)	2.56 (0.651)	**0.010***
	F Memory	3 (0.000)	2.95 (0.213)	3 (0.000)	3 (0.000)	–
	Calculation	4.47 (0.857)	4.53 (0.830)	4.61 (0.827)	4.48 (0.872)	0.309
	Attention	1.31 (1.122)	1.81 (1.227)	2.03 (1.212)	1.92 (1.187)	**0.006***
	Language	5.24 (0.710)	5.81 (0.495)	5.55 (0.711)	5.96 (0.200)	**<0.001****
	Praxis	4.29 (0.672)	4.53 (0.584)	4.33 (0.736)	4.80 (0.408)	**0.005***
	Set-Test	96.12 (6.476)	38.89 (2.088)	39.15 (1.955)	39.20 (1.936)	0.069
	Barthel	98.28 (3.553)	97.55 (6.331)	97.15 (5.867)	98 (5.204)	0.600
	Lawton	7.40 (1.233)	7.61 (0.794)	7.55 (0.905)	7.56 (0.768)	0.356
	Goldberg	2.81 (2.687)	2.81 (2.245)	3.14 (2.356)	2.66 (2.375)	0.611
	GDS-15	2.90 (2.581)	2.60 (5.670)	2.73 (2.024)	1.90 (1.926)	0.349
	MEC-35	25.98 (0.989)	29.12 (2.705)	29.83 (2.632)	30.05 (2.527)	**<0.001****
	Cognitive aspects					
LEVEL DETERIORATION GROUP	*T Orientation*	3.96 (1.020)	4.63 (0.633)	4.46 (0.932)	4.42 (0.769)	**0.002***
	S Orientation	4.20 (0.790)	4.50 (0.726)	4.88 (0.338)	4.68 (0.582)	**0.001***
	S-T Memory	1.08 (1.057)	1.58 (1.056)	2.33 (0.816)	2.58 (0.507)	**<0.001****
	F Memory	3 (0.000)	3 (0.000)	3 (0.000)	3 (0.000)	–
	Calculation	3.67 (1.345)	4.24 (1.076)	4.13 (1.191)	4.11 (0.994)	0.168
	Attention	1.04 (1.098)	1.37 (1.195)	1.33 (1.239)	1.42 (1.216)	0.318
	Language	4.84 (0.874)	5.24 (0.943)	5.29 (0.806)	5.32 (0.885)	0.134
	Praxis	4.18 (0.808)	4.58 (0.642)	4.38 (0.711)	4.47 (0.612)	0.133
	Set-Test	37.18 (3.644)	37.92 (3.035)	38.42 (2.535)	39.05 (1.870)	**<0.001***
	Barthel	96.71 (7.971)	96.45 (6.463)	95.63 (9.006)	95.26 (9.048)	0.871
	Lawton	7.27 (1.319)	7.24 (1.261)	7.42 (1.213)	7.37 (1.342)	0.308
	Goldberg	3.35 (2.343)	3.08 (2.350)	2.60 (2.016)	3.105(2.390)	0.301
	GDS-15	3.06 (2.631)	2.92 (3.107)	2.15 (1.879)	2.658 (2.490)	0.376

	Variables	*Basal* *(n = 10)* *Mean* *(Std)*	*Post-I* *(n=)* *Mean* *(Std)*	*6 months* *(n = 3)* *Mean* *(Std)*	*p-value*
	MEC-35	22.20 (1.033)	24 (3.162)	22.67 (4.726)	0.761
	Cognitive aspects				
MODERATE DETERIORATION GROUP	*T Orientation*	2.70 (1.494)	3 (1.826)	2.67 (2.517)	0.368
DETERIORATION GROUP	*S Orientation*	4.30 (0.949)	3.70 (1.160)	4 (1.000)	0.368
	S-T Memory	0.20 (0.632)	1.70 (2.830)	1.33 (1.155)	0.223
	F Memory	3 (0.000)	3 (0.000)	3 (0.000)	–
	Calculation	3 (1.633)	3.50 (1.509)	1.33 (1.528)	0.441
	Attention	0.90 (1.197)	1.60 (1.075)	1.67 (1.155)	0.368
	Language	4.30 (1.160)	4.60 (0.966)	5 (1.000)	0.223
	Praxis	3.80 (0.789)	3.40 (1.350)	3.67 (0.577)	0.670
	Set-Test	30.30 (4.473)	30.30 (5.599)	26.33 (9.713)	0.761
	Barthel	97 (4.830)	95 (4.714)	96.67 (5.774)	0.717
	Lawton	6.40 (1.713)	6.80 (2.098)	4.33 (3.215)	0.717
	Goldberg	2.75 (2.595)	1.60 (1.630)	1.83 (2.363)	0.273
	GDS-15	2.85 (2.868)	1.90 (2.079)	0.67 (0.764)	0.497

Dif Mean: Difference of Mean; F: Fixation; Goldberg: Goldberg anxiety sub-scale; GDS-15: Yesavage geriatric depression scale, 15-point version; S: Spatial; S-T: Short-term; MEC-35: Spanish version of the Mini-Mental State Examination.
Post-I: Post-intervention.
* Means p-value <0.05, and.
** means p-value < 0.001.

Table 4
Differences between groups by age at basal, post-intervention, 6 and 12 months in the different outcome variables by groups.

		Basal			*Post-Intervention*				*6 months*				*12 months*			
	Variables	*IG (n = 34) Mean (Std)*	*CG (n30) Mean (Std)*	*p-value*	*IG (n = 23) Mean (Std)*	*CG (n = 27) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 18) Mean (Std)*	*CG (n = 23) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 16) Mean (Std)*	*CG (n = 16) Mean (Std)*	*Dif. Mean*	*p-value*
	≤ ***74 years***	33.20	33.21	0.950	33.89	32.96	0.93	**0.011**	33.87	33.22		0.197	34.06	32.81	1.25	**0.017**
	MEC-35	(1.031)	(0.978)		(1.013)	(1.331)			(1.517)	(1.700)			(1.731)	(1.759)		
	Cognitive aspects															
NO DETERIORATION GROUP	*T Orientation*	4.80	4.88	0.778	4.85	4.74	0.11	0.492	4.96	4.67	0.29	**0.036**	4.75	4.69	0.06	0.695
		(0.551)	(0.327)		(0.362)	(0.541)			(0.209)	(0.594)			(0.577)	(0.602)		
	S Orientation	4.83	4.94	0.299	4.93	4.96	-0.03	0.653	4.94	4.94	0.00	0.999	4.94	4.94	0.00	0.317
		(0.461)	(0.239)		(0.267)	(0.209)			(0.250)	(0.250)			(0.250)	(0.250)		
	S-T Memory	2.40	2.44	0.668	2.70	2.57	0.13	0.566	2.78	2.78	0.00	0.760	2.94	2.38	0.56	**0.030**
		(0.675)	(0.746)		(0.465)	(0.662)			(0.518)	(0.428)			(0.250)	(0.957)		
	F Memory	3	3	0.999	3	3	0.00	0.999	3	3	0.00	0.999	3	3	0.00	0.999
		(0.000)	(0.000)		(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)		
	Calculation	4.93	4.88	0.488	4.96	4.83	0.13	0.111	4.87	4.89	-0.02	0.853	4.88	4.88	0.00	0.999
		(0.254)	(0.327)		(0.192)	(0.388)			(0.344)	(0.323)			(0.342)	(0.342)		
	Attention	2.63	2.62	0.926	2.70	2.61	0.09	0.760	2.70	2.39	0.31	0.388	2.75	2.63	0.12	0.632
		(0.850)	(0.853)		(0.724)	(0.891)			(0.822)	(1.195)			(0.683)	(0.806)		
	Language	5.80	5.74	0.394	5.93	5.87	0.06	0.836	5.96	5.89	0.07	0.415	5.88	5.88	0.00	0.151
		(0.484)	(0.448)		(0.267)	(0.458)			(0.209)	(0.323)			(0.342)	(0.342)		
	Praxis	4.80	4.71	0.272	4.81	4.39	0.42	**0.010**	4.61	4.61	0.00	0.950	4.81	4.38	0.43	**0.027**
		(0.484)	(0.462)		(0.396)	(0.656)			(0.583)	(0.608)			(0.403)	(0.619)		
	Set-Test	39.30	39.44	0.708	39.33	39.74	-0.41	0.521	39.65	39.83	-0.18	0.564	39.69	39.50	0.19	0.794
		(1.208)	(0.960)		(1.301)	(0.449)			(0.935)	(0.514)			(0.602)	(1.317)		
	Barthel	98.67	97.50	0.323	98.52	99.13	-0.61	0.809	98.70	99.44	-0.74	0.878	99.06	99.69	-0.63	0.526
		(3.925)	(6.657)		(4.117)	(2.455)			(4.322)	(1.617)			(2.720)	(1.250)		
	Lawton	7.33	7.41	0.634	7.33	6.83	0.50	0.312	7.30	7.44	-0.14	0.512	7.63	7.44	0.19	0.639
		(1.155)	(1.104)		(1.038)	(1.557)			(1.063)	(1.149)			(0.885)	(2.094)		
	Goldberg	3.20	2.65	0.436	3.50	3.28	0.22	0.837	2.74	2.61	0.13	0.874	2.50	1.91	-0.59	0.489
		(2.434)	(2.500)		(2.066)	(2.549)			(2.340)	(2.040)			(1.975)	(1.369)		
	GDS-15	2.28	2.426	0.797	2.17	3.46	1.29	0.623	1.48	1.94	-0.46	0.479	1.28	1.75	0.37	0.492
		(2.23)	(2.125)		(2.345)	(2.402)			(1.892)	(2.057)			(1.426)	(1.703)		

	Basal			*Post-Intervention*				*6 months*				*12 months*			
Variables	*IG (n = 17) Mean (Std)*	*CG (n = 20) Mean (Std)*	*p-value*	*IG (n = 12) Mean (Std)*	*CG (n = 18) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 11) Mean (Std)*	*CG (n = 14) Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 8) Mean (Std)*	*CG (n = 9) Mean (Std)*	*Dif. Mean*	*Mean (Std)*
> 75 years	33.05	33.41	0.341	32.83	31.33	1.50	**0.019**	33.43	31.91	1.48	0.054	33.38	32.11	1.27	**0.049**
MEC-35	(0.999)	(1.121)		(1.689)	(1.557)			(1.651)	(1.921)			(1.598)	(1.054)		
Cognitive aspects															
T Orientation	4.80	4.94	0.478	4.72	4.75	-0.03	0.931	4.86	4.45	0.41	0.164	3.67	3.67	0.00	–
	(0.410)	(0.243)		(0.575)	(0.452)			(0.036)	(0.820)			(1.000)	(1.000)		
S Orientation	4.80	4.94	0.478	4.78	4.92	-0.04	0.326	4.79	4.82	-0.03	0.844	4.78	4.78	0.00	0.168
	(0.410)	(0.243)		(0.428)	(0.289)			(0.426)	(0.405)			(0.441)	(0.441)		
S-T Memory	2.25	2.18	0.940	2.39	1.58	0.81	0.055	2.50	1.91	0.59	0.212	2.38	2.67	0.29	0.406
	(0.786)	(1.015)		(0.850)	(1.165)			(0.855)	(1.221)			(0.744)	(0.500)		
F Memory	3	3	0.999	3	3	0.00	0.999	3	3	0.00	0.999	3	3	0.00	0.999
	(0.000)	(0.000)		(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)		
Calculation	4.95	4.76	0.517	4.72	4.72	0.00	0.143	4.79	4.64	0.15	0.764	4.75	4.89	0.14	0.467
	(0.224)	(0.562)		(0.669)	(0.669)			(0.579)	(0.924)			(0.463)	(0.333)		

(*continued on next page*)

Table 4 (*continued*)

Variables	*Basal*			*Post-Intervention*				*6 months*				*12 months*			
	IG (n = 17) Mean (Std)	***CG (n = 20) Mean (Std)***	***p-value***	***IG (n = 12) Mean (Std)***	***CG (n = 18) Mean (Std)***	***Dif. Mean***	***p-value***	***IG (n = 11) Mean (Std)***	***CG (n = 14) Mean (Std)***	***Dif. Mean***	***p-value***	***IG (n = 8) Mean (Std)***	***CG (n = 9) Mean (Std)***	***Dif. Mean***	***Mean (Std)***
Attention	2.60 (0.821)	2.88 (0.485)	0.478	2.56 (0.856)	2.67 (0.778)	-0.09	0.714	2.86 (0.535)	2.82 (0.603)	0.04	0.861	2.50 (0.926)	2.78 (0.667)	0.28	0.467
Language	5.70 (0.470)	5.88 (0.332)	0.357	5.89 (0.323)	5.75 (0.452)	0.14	0.326	5.79 (0.802)	5.91 (0.302)	0.12	0.907	5.78 (0.441)	5.78 (0.441)	0.00	0.168
Praxis	4.95 (0.224)	4.82 (0.393)	0.517	4.78 (0.428)	3.67 (0.651)	1.11	**<0.001**	4.86 (0.363)	4.36 (0.674)	0.50	**0.032**	4.75 (0.463)	4.56 (0.527)	0.19	0.417
Set-Test	38.90 (1.997)	38.00 (2.398)	0.326	38.61 (1.819)	38.42 (2.811)	0.19	0.718	38.36 (1.985)	38.73 (2.284)	-0.37	0.408	37.63 (4.627)	39.56 (0.726)	-1.93	0.651
Barthel	97.50 (5.000)	96.47 (5.524)	0.537	97.78 (4.278)	97.08 (7.525)	0.70	0.627	98.21 (3.156)	98.18 (4.045)	0.03	0.714	99.38 (1.768)	98.33 (3.536)	1.05	0.562
Lawton	7.45 (0.887)	6.82 (1.468)	0.232	7.06 (1.259)	7.00 (1.128)	0.06	0.803	7.14 (1.231)	7.18 (1.168)	0.04	0.808	7.63 (0.518)	7.11 (1.054)	0.52	0.355
Goldberg	2.725 (2.505)	3.176 (2.767)	0.662	3.11 (2.2658)	3.04 (2.509)	0.07	0.831	2.14 (2.663)	1.86 (2.146)	-0.28	0.911	1.69 (1.907)	2.06 (1.895)	0.37	0.626
GDS-15	2.10 (2.023)	3.29 (3.093)	0.311	1.81 (2.243)	2.54 (4.418)	0.73	0.679	1.68 (2.743)	1.82 (2.732)	0.14	0.478	1.06 (2.412)	0.94 (1.014)	0.12	0.363

	Variables	*Basal*			*Post-Intervention*				*6 months*				*12 months*			
		IG (n = 36) Mean (Std)	***CG (n = 18) Mean (Std)***	***p-value***	***IG (n = 34) Mean (Std)***	***CG (n = 10) Mean (Std)***	***Dif. Mean***	***p-value***	***IG (n = 23) Mean (Std)***	***CG (n = 8) Mean (Std)***	***Dif Mean***	***p-value***	***IG (n = 18) Mean (Std)***	***CG (n = 6) Mean (Std)***	***Dif. Mean***	***p-value***
	≤ 74 years	29.53 (1.028)	29.56 (0.922)	0.950	31.79 (1.981)	30.50 (2.799)	1.29	0.104	32.17 (2.037)	31.00 (1.852)	1.17	0.120	32.17 (2.065)	30.50 (2.074)	1.67	0.195
	MEC-35 Cognitive aspects															
SUBTLE COGNITIVE IMPAIRMENT GROUP	*T Orientation*	4.81 (0.401)	4.78 (0.428)	0.778	4.76 (0.496)	4.80 (0.422)	0.04	0.936	4.83 (0.491)	4.38 (0.916)	0.45	0.116	4.78 (0.428)	4.33 (1.033)	0.45	0.348
	S Orientation	4.92 (0.280)	4.72 (0.575)	0.299	4.82 (0.521)	4.90 (0.316)	0.08	0.839	4.87 (0.344)	4.88 (0.354)	-0.01	0.969	4.83 (0.514)	4.50 (1.225)	0.833	0.612
	S-T Memory	1.72 (0.882)	1.61 (0.916)	0.668	2.26 (0.790)	1.40 (1.350)	0.86	0.067	2.65 (0.573)	2.13 (0.991)	0.52	0.158	2.56 (0.616)	1.83 (1.169)	0.73	0.208
	F Memory	3 (0.000)	3 (0.000)	0.9999	2.90 (0.316)	2.90 (0.316)	0.00	0.065	3 (0.000)	3 (0.000)	0.00	0.999	3 (0.000)	3 (0.000)	0.00	0.999
	Calculation	4.42 (0.874)	4.67 (0.485)	0.488	4.62 (0.779)	4.60 (0.699)	0.02	0.888	4.70 (0.470)	4.63 (0.744)	0.07	0.932	4.28 (0.958)	4.50 (1.225)	-0.22	0.414
	Attention	1.14 (1.018)	1.06 (0.998)	0.926	1.79 (1.122)	2.30 (1.160)	-0.51	0.224	2.13 (1.180)	2.13 (0.991)	0.00	0.879	1.89 (1.183)	1.50 (1.225)	0.39	0.629
	Language	5.22 (0.681)	5.28 (0.752)	0.394	5.88 (0.327)	5.30 (1.160)	0.58	0.103	5.65 (0.714)	5.63 (0.744)	0.02	0.999	5.94 (0.236)	5.94 (0.236)	0.00	0.574
	Praxis	4.31 (0.710)	4.44 (0.922)	0.272	4.59 (0.557)	4.30 (0.823)	0.29	0.325	4.35 (0.714)	4.25 (0.707)	0.10	0.581	4.89 (0.323)	4.83 (0.408)	0.06	0.960
	Set-Test	38.47 (2.467)	38.94 (1.514)	0.708	39.26 (1.990)	38.60 (2.066)	0.66	0.191	39.26 (2.137)	39.00 (1.195)	0.26	0.087	39.78 (0.548)	39.78 (0.548)	0.00	0.231
	Barthel	98.33 (3.381)	97.78 (3.524)	0.323	97.21 (7.092)	97.00 (3.496)	-0.21	0.185	96.96 (6.350)	95.63 (6.781)	1.33	0.746	97.78 (5.996)	95.83 (6.646)	1.95	0.658
	Lawton	7.43 (1.271)	7.56 (0.984)	0.634	7.53 (0.847)	7.60 (0.966)	0.07	0.879	7.61 (0.941)	7.50 (1.069)	0.11	0.910	7.67 (0.686)	7.83 (0.408)	0.16	0.750
	Goldberg	2.99 (2.565)	2.42 (2.002)	0.436	2.81 (2.377)	4.30 (2.003)	1.49	0.057	3.24 (2.4819	3.63 (2.615)	-0.39	0.887	2.83 (2.509)	4.58 (2.836)	1.75	0.155
	GDS-15	3.31 (2.799)	2.19 (1.664)	0.797	2.94 (2.513)	3.25 (3.369)	0.31	0.932	2.85 (2.047)	2.25 (2.121)	0.60	0.229	2.11 (2.026)	2.50 (2.074)	0.39	0.687

Variables	Basal			Post-Intervention				6 months				12 months			
	IG (n = 15) Mean (Std)	CG (n = 31) Mean (Std)	p-value	IG (n = 13) Mean (Std)	CG (n = 12) Mean (Std)	Dif. Mean	p-value	IG (n = 10) Mean (Std)	CG (n = 6) Mean (Std)	Dif. Mean	p-value	IG (n = 7) Mean (Std)	CG (n = 5) Mean (Std)	Dif. Mean	p-value
> 75 years	29.47	29.29	0.310	30.23	28.83	1.40	0.089	30.40	29.20	1.20	0.137	32.00	29.60	2.40	0.077
MEC-35	(0.990)	(1.101)		(1.964)	(2.657)			(2.221)	(1.924)			(2.309)	(2.191)		
Cognitive aspects															
T Orientation	4.27	4.29	0.217	4.15	3.92	0.23	0.999	4.90	3.40	1.50	**0.017**	3.86	3.80	-0.14	0.145
	(1.100)	(0.824)		(1.214)	(1.730)			(0.316)	(1.517)			(1.773)	(0.447)		
S Orientation	4.67	4.77	0.217	4.85	4.33	0.52	**0.026**	4.80	4.80	0.00	0.474	4.80	4.80	0.00	0.206
	(0.488)	(0.497)		(0.376)	(0.651)			(0.422)	(0.447)			(0.447)	(0.447)		
S-T Memory	1.67	1.42	0.934	2.08	1.83	0.25	0.533	1.90	2.20	0.30	0.954	2.57	1.60	0.97	0.155
	(0.900)	(1.148)		(0.641)	(0.937)			(1.197)	(1.304)			(0.787)	(2.300)		
F Memory	3	3	0.999	3	3	0.00	0.999	3	3	0.00	0.999	3	3	0.00	0.999
	(0.000)	(0.000)		(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)		
Calculation	4.60	4.58	0.213	4.31	4.50	0.19	0.654	4.40	4.60	0.20	0.775	4.80	4.80	0.00	0.726
	(0.828)	(0.502)		(0.947)	(0.798)			(1.350)	(0.548)			(0.447)	(0.447)		
Attention	1.73	1.55	0.217	1.85	1.92	-0.07	0.953	1.80	1.60	0.20	0.817	2.00	1.60	0.40	0.466
	(1.280)	(1.234)		(1.519)	(1.379)			(1.317)	(1.342)			(1.291)	(1.342)		
Language	5.27	5.26	0.185	5.62	5.33	0.29	0.170	5.30	5.40	-0.10	0.473	5.60	5.60	0.00	0.062
	(0.799)	(0.930)		(0.768)	(0.651)			(0.675)	(0.894)			(0.548)	(0.548)		
Praxis	4.27	4.42	0.223	4.38	4.00	0.38	0.182	4.30	4.20	0.10	0.550	4.57	4.40	0.17	0.735
	(0.594)	(0.620)		(0.650)	(0.739)			(0.823)	(0.447)			(0.535)	(0.548)		
Set-Test	36.67	36.97	0.283	37.92	37.58	0.34	0.465	38.90	37.00	1.90	0.369	37.71	39.40	-1.69	0.695
	(3.395)	(3.987)		(2.100)	(3.777)			(1.524)	(3.082)			(3.251)	(0.548)		
Barthel	98.17	95.16	0.461	98.46	96.25	2.21	0.459	97.50	91.00	6.50	0.262	98.57	94.00	4.57	0.103
	(4.061)	(7.581)		(3.755)	(7.11)			(4.859)	(10.940)			(2.440)	(5.477)		
Lawton	7.33	7.03	0.175	7.54	6.25	1.29	0.059	7.40	5.00	2.40	0.325	7.29	5.40	1.89	0.151
	(1.175)	(1.278)		(0.660)	(1.658)			(0.843)	(3.000)			(0.951)	(2.608)		
Goldberg	2.40	2.44	0.643	2.81	3.29	0.48	0.583	2.90	2.70	0.20	0.448	2.21	2.90	0.71	0.555
	(3.013)	(2.425)		(1.942)	(1.305)			(2.145)	(1.789)			(2.099)	(2.434)		
GDS-15	1.93	3.34	0.294	1.69	3.83	2.14	0.130	2.45	4.30	1.85	0.447	1.36	4.80	3.44	**0.039**
	(1.668)	(3.494)		(1.774)	(3.512)			(2.047)	(4.970)			(1.651)	(4.102)		

	Variables	Basal			Post-Intervention				6 months				12 months			
		IG (n = 27) Mean (Std)	CG (n = 28) Mean (Std)	p-value	IG (n = 23) Mean (Std)	CG (n = 21) Mean (Std)	Dif. Mean	p-value	IG (n = 14) Mean (Std)	CG (n = 15) Mean (Std)	Dif. Mean	p-value	IG (n = 10) Mean (Std)	CG (n = 11) Mean (Std)	Dif. Mean	p-value
	≤ 74 years	25.89	25.82	0.950	29.22	27.05	2.17	**0.032**	30.07 (2.586)	27.00	3.07	**0.041**	30.10	28.73	1.37	0.189
	MEC-35	(0.974)	(0.983)		(2.593)	(14.048)				(4.551)			(2.767)	(3.197)		
	Cognitive aspects															
LEVEL DETERIORATION GROUP	*T Orientation*	3.93	3.96	0.778	4.65	3.86	0.79	**0.026**	4.50	4.00	0.50	0.609	4.40	4.00	0.40	0.397
		(0.917)	(1.232)		(0.487)	(1.389)			(0.650)	(1.558)			(0.843)	(1.095)		
	S Orientation	4.33	4.54	0.299	4.52	4.48	0.04	0.858	4.86	4.20	0.66	**0.010**	4.60	4.45	0.15	0.539
		(0.784)	(0.576)		(0.665)	(0.873)			(0.363)	(0.775)			(0.699)	(0.688)		
	S-T Memory	1.15	1.00	0.668	1.57	1.48	0.09	0.844	2.50	1.67	0.83	**0.018**	2.60	1.91	0.69	0.110
		(1.027)	(0.943)		(1.037)	(1.078)			(0.855)	(0.976)			(0.516)	(1.044)		
	F Memory	2.96	2.96	0.999	3	3	0.00	0.999	3	3	0.00	0.999	3	3	0.00	0.999
		(0.192)	(0.192)		(0.000)	(0.000)			(0.000)	(0.000)			(0.000)	(0.000)		
	Calculation	3.33	3.82	0.488	4.09	3.57	0.52	0.292	4.07	3.27	0.80	0.083	3.90	4.55	-0.65	0.134
		(1.468)	(1.335)		(1.240)	(1.720)			(1.207)	(1.534)			(1.101)	(0.820)		
	Attention	1.00	1.00	0.926	1.57	2.76	-1.19	0.482	1.29	1.53	-0.24	0.506	1.50	1.45	0.05	0.795
		(1.177)	(0.943)		(1.237)	(1.044)			(1.139)	(1.060)			(1.179)	(1.508)		
	Language			0.394			0.41	0.133			0.36	0.263			0.49	0.091

(continued on next page)

Table 4 (*continued*)

Variables	*Basal*			*Post-Intervention*				*6 months*				*12 months*			
	IG (n = 27) ***Mean (Std)***	***CG (n = 28)*** ***Mean (Std)***	***p-value***	***IG (n = 23)*** ***Mean (Std)***	***CG (n = 21)*** ***Mean (Std)***	***Dif. Mean***	***p-value***	***IG (n = 14)*** ***Mean (Std)***	***CG (n = 15)*** ***Mean (Std)***	***Dif. Mean***	***p-value***	***IG (n = 10)*** ***Mean (Std)***	***CG (n = 11)*** ***Mean (Std)***	***Dif. Mean***	***p-value***
	4.85 (0.818)	4.61 (0.994)		5.22 (0.951)	4.81 (0.981)			5.43 (0.852)	5.07 (0.961)			5.40 (1.075)	4.91 (0.701)		
Praxis	4.30 (0.775)	3.96 (0.744)	0.272	4.61 (0.499)	4.10 (1.136)	0.51	0.171	4.43 (0.646)	4.33 (0.816)	0.10	0.864	4.60 (0.516)	4.45 (0.688)	0.15	0.686
Set-Test	38.15 (2.365)	36.25 (3.307)	0.708	38.61 (2.126)	36.90 (4.908)	1.71	0.339	38.93 (1.817)	35.33 (7.413)	3.60	0.363	39.00 (1.886)	37.82 (2.676)	1.18	0.253
Barthel	94.81 (9.853)	97.32 (5.850)	0.323	96.52 (7.452)	97.14 (5.606)	-0.62	0.627	97.86 (4.688)	95.00 (9.258)	2.86	0.421	98.00 (4.830)	93.64 (8.090)	4.36	0.177
Lawton	7.56 (0.974)	7.21 (1.663)	0.634	7.43 (1.080)	6.90 (1.786)	0.53	0.246	7.86 0.535)	7.27 (1.223)	0.59	0.051	7.80 (0.632)	7.55 (0.522)	0.25	0.129
Goldberg	3.46 (2.541)	2.84 (2.642)	0.436	2.74 (2.602)	3.41 (2.668)	0.67	0.379	2.50 (1.850)	3.60 (2.422)	1.10	0.210	3.35 (3.065)	3.72 (3.220)	0.37	0.887
GDS-15	3.35 (3.162)	3.16 (3.364)	0.797	2.78 (3.302)	4.55 (3.924)	1.77	0.124	1.68 (1.527)	4.37 (4.361)	2.69	0.153	2.50 (2.112)	4.32 (4.314)	1.82	0.357

Variables	*Basal*			*Post-Intervention*				*6 months*				*12 months*			
	IG (n = 22) *Mean (Std)*	*CG (n = 31)* *Mean (Std)*	*p-value*	*IG (n = 15)* *Mean (Std)*	*CG (n = 23)* *Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 10)* *Mean (Std)*	*CG (n = 16)* *Mean (Std)*	*Dif. Mean*	*p-value*	*IG (n = 9)* *Mean (Std)*	*CG (n = 13)* *Mean (Std)*	*Dif. Mean*	*p-value*
> 75 years	26.09	25.45	0.310	28.97	26.26	2.71	0.062	29.50	27.31	2.19	0.167	30.00	26.54	3.46	0.060
MEC-35	(1.019)	(1.060)		(2.955)	(4.403)			(2.799)	(3.610)			(2.398)	(4.576)		
Cognitive aspects															
T Orientation	4.00 (1.155)	3.68 (1.077)	0.217	4.60 (0.828)	3.74 (1.214)	0.86	**0.005**	4.40 (1.265)	3.63 (1.147)	0.77	**0.037**	4.44 (0.726)	3.69 (1.377)	0.75	0.147
S Orientation	4.05 (0.785)	4.42 (0.720)	0.217	4.47 (0.834)	4.48 (0.898)	-0.01	0.890	4.90 (0.316)	4.56 (0.727)	0.34	0.197	4.78 (0.441)	4.77 (0.599)	0.01	0.765
S-T Memory	1.00 (1.113)	0.52 (0.677)	0.934	1.60 (1.121)	1.22 (1.166)	0.38	0.411	2.10 (0.738)	1.50 (1.1559	0.60	0.188	2.56 (0.527)	1.38 (1.325)	1.18	**0.045**
F Memory	3 (0.000)	3 (0.000)	0.999	3 (0.000)	3 (0.000)	0.00	0.999	3 (0.000)	3 (0.000)	0.00	0.999	3 (0.000)	3 (0.000)	0.00	0.999
Calculation	4.09 (1.065)	3.71 (1.296)	0.213	4.47 (0.743)	3.70 (1.717)	0.77	0.230	4.20 (1.229)	3.38 (1.360)	0.82	0.089	4.33 (0.866)	3.23 (1.301)	1.10	**0.041**
Attention	1.09 (1.019)	1.23 (1.146)	0.217	1.07 (1.100)	1.22 (1.043)	-0.15	0.449	1.40 (1.4309	2.00 (1.095)	-0.60	0.213	1.33 (1.323)	1.38 (1.044)	-0.05	0.748
Language	4.82 (0.958)	4.52 (0.926)	0.185	5.27 (0.961)	4.65 (1.112)	0.62	0.064	5.10 0.7389	4.88 (1.088)	0.22	0.698	5.22 (0.667)	4.46 (0.967)	0.76	0.057
Praxis	4.05 (0.844)	4.23 (0.717)	0.223	4.53 (0.834)	4.22 (0.795)	0.31	0.127	4.30 (0.823)	4.38 (0.806)	-0.18	0.793	4.33 (0.707)	4.46 (0.660)	-0.13	0.656
Set-Test	36.00 (4.557)	32.68 (5.879)	0.283	36.87 (3.907)	35.39 (5.655)	1.48	0.230	37.70 (3.268)	35.13 (4.319)	2.57	0.052	39.11 (1.965)	36.54 (4.390)	2.57	0.072
Barthel	96.82 (4.767)	95.16 (6.517)	0.461	96.33 (4.806)	93.80 (8.044)	2.53	0.389	92.50 (12.528)	94.91 (8.009)	-2.41	0.930	92.22 (11.756)	95.77 (6.405)	-3.55	0.714
Lawton	6.91 (1.601)	5.94 (2.065)	0.175	6.93 (1.486)	5.87 (2.007)	1.06	0.108	6.80 (1.619)	6.50 (1.619)	0.30	0.525	6.89 (1.764)	7.00 (1.000)	-0.11	0.807
Goldberg	3.21 (2.125)	2.71 (2.272)	0.643	3.60 (1.863)	2.59 (1.788)	-1.01	0.142	2.75 (2.324)	2.22 (2.345)	0.53	0.472	2.83 (1.458)	2.27 (2.242)	-0.56	0.379
GDS-15	2.71 (1.791)	3.36 (2.430)	0.294	3.13 (2.881)	2.80 (2.895)	-0.33	0.569	2.80 (2.201)	2.28 (2.846)	-0.52	0.351	3.11 (2.913)	3.65 (3.960)	-0.54	0.892

2014), with computerized interventions (P. Gamito et al., 2020; Tarnanas et al., 2014), with interventions of longer duration in all studies except one (Park et al., 2019). We have not found any studies of participants with SCI based on CS programs. Bhome et al. (2018) commented in their meta-analysis, that overall cognitive training interventions offered led to a small, statistically significant improvement in objective cognitive performance in participants with subjective cognitive decline.

In agreement with our results, other authors also found no significant differences in participants with dementia, between groups (Capotosto et al., 2017; Liu et al., 2021; López et al., 2022), all of them administered adapted CS but with a higher number of sessions. Two of them applied participants living in a community and within group (Alvares-Pereira et al., 2021; J Alves et al., 2014; Capotosto et al., 2017; Cove et al., 2014; Gibbor et al., 2021; Justo-Henriques et al., 2021; López et al., 2022; Miranda-Castillo et al., 2013; Orrell et al., 2012; Orgeta et al., 2015), four of these studies applied to in younger aged older adults (J Alves et al., 2014; Cove et al., 2014; Justo-Henriques et al., 2021; Orgeta et al., 2015), and five administered adapted CS (Jorge Alves et al., 2014; Capotosto et al., 2017; Cove et al., 2014; Gibbor et al., 2021; López et al., 2022). Of all studies applying a higher number of sessions, three studies involved in community-dwelling participants (Cove et al., 2014; López et al., 2020; Orgeta et al., 2015) and all of them but one in European participants (Miranda-Castillo et al., 2013).

Regarding to ***cognitive functions***, our program achieved statistically significant enhancements between groups: 1) in TO at 6 and 12 months and P post-intervention and at 12 months in the ND group; 2) in SO post-intervention, TO at 6 months, STM and L post-intervention in the SCI group; 3) in TO post-intervention and at 6 months, SO at 6 months, STM at 6 and 12 months, C at 6 months, L post-intervention and 12 months and P post-intervention in the LD group. There were significant improvements within group: 1) in STM and L in LD group; 2) in STM, A, L, and P in the SCI group; and 3) in TO, ST and STM in the LD group. These findings are important for several reasons: 1) First, STM may be of great relevance given that it declines as people age (Esmaeili et al., 2022). Besides, the existence of an age-dependent relational link in STM could be explained, by less cognitive control (Schmiedek, 2009); 2) Secondly, spoken language impairment can be one of the first signs of cognitive impairment (Beltrami et al., 2018); 3) Third, a significant degree of attention processing problems can be seen in subjective cognitive decline (Esmaeili et al., 2022); and frequently results in deficits in cognitive domains such as memory, TO (Ribeiro et al., 2006) and SO (Quimas et al., 2022) in MCI.

Other CS programs also found significant differences within group in STM and L in participants with normal cognition (Park et al., 2019), in participants with MCI in STM between groups post-intervention (Ciarmiello et al., 2015; P. Gamito et al., 2020; Moro et al., 2015; Tarnanas et al., 2014) and at 6 months follow-up (Moro et al., 2015) and within group post-intervention (Tarnanas et al., 2014) through other instruments (Boston Naming Test). Three them had an intervention with a longer duration (Ciarmiello et al., 2015; Moro et al., 2015; Tarnanas et al., 2014). In addition, different meta-analyses also reported significant improvements through cognitive training on measures of memory in healthy older adults (Kelly, 2015; Roheger & Flöel, 2021), and there was a small effect on objective memory in participants with subjective cognitive decline (Sheng et al., 2020).

These findings on memory are very important as clinically significant improvements in memory might be associated with improved quality of life and general well-being for both patients and caregivers (De Marco et al., 2016).

Regarding ***semantic fluency***, we found significant differences in the S-T between group, post-intervention, at 6 months and 12 months and within group in the LD group. In other studies, in participants with MCI also found differences within group post-intervention (Luque et al., 2010; Tarnanas et al., 2014), and between groups at the 3-month follow-up assessment (Jemmi -Djabelkhir et al., 2018); all studies involved a higher number of sessions (Jemmi -Djabelkhir et al., 2018; Luque et al., 2010; Tarnanas et al., 2014) and two of them had computerized interventions (Jemmi -Djabelkhir et al., 2018; Tarnanas et al., 2014). A multicomponent cognitive intervention program is observed significant differences in semantic fluency between older adults with MCI and mild dementia and also between older adults with normal cognition and older adults with subjective cognitive complaints (Facal et al., 2009). These findings are highly relevant because language assessments, especially verbal fluency and comprehension, are good indicators of cognitive impairment (Maseda et al., 2014).

About ***AVDs***, our study showed improvements in IADLs, in accordance with the L-B scale between groups in the SCI group post-intervention and in the LD group post-intervention and at 6 months after the intervention. Other CS programs found improves in IBDLs measured by the same instrument in healthy participants with normal aging, cognitive impairment (Carballo-García et al., 2013). Moreover, also found differences in ADLs (BADLs, IADLs, and leisure activities) in participants with mild to moderate dementia through the Disability Assessment for Dementia, managing more CS sessions (Capotosto et al., 2017). Programs based on other cognitive interventions can also help to improve IADLs in older adults with normal cognition (Fan & Wong, R. Y, 2019; Rebok et al., 2014). The level of IADLs function is very important for an older adult's autonomy. A Delphi study suggests that IADLs functioning is affected by cognitive function factors, physical function factors, environmental factors, and personal factors (Bruderer-hofstetter et al., 2020). In the meta-analysis of Lindbergh et al. (2016), older adults with MCI had greater limitations in IADLs compared to older adults with normal cognition.

Furthermore, our results indicated that older adults with SCI and MD between groups and older adults ND within group, showed an improvement in the ***levels of anxiety*** according to the Goldberg subscale. Others programs with participants with healthy normal aging, cognitive impairment (Carballo-García et al., 2013), and mild to moderate dementia (Emanuela Capotosto et al., 2017) showed significant differences in the levels of anxiety between groups, through multicomponent and adapted CS measured by other instruments and with a greater number of sessions. Unlike our study, Carcelén-Fraile et al. (2022) found significant differences in participants with MCI. This could be explained in part because tailored and personalized non-pharmacological interventions seem to work better in older adults who present high levels of anxiety if the needs, expectations, and cultural background are taken into account (Andreescu & Lee, 2020).

However, our study found no significant differences in any group in depression. Other authors, also found no differences across healthy participants (Casemiro et al., 2016), and those with MCI (Ciarmiello et al., 2015; Djabelkhir et al., 2017; Juárez-Cedillo et al., 2020; Tarnanas et al., 2014), and dementia (Alvares-Pereira et al., 2021; Carbone et al., 2021; Coen et al., 2011; P. Gamito et al., 2020; Orgeta et al., 2015; Piras et al., 2017; Tsai et al., 2019).

If we analyze the differences according to age group in our study, we can see the following differences ($\leq$ 74 years and $>$ 75 years). In the ND group in participants $\leq$ 74 years we can observe greater benefits based on TO and STM. In the SCI group in participants $>$ 75 years, we observed significant improvements in SO, TO, and depressive symptoms; however, in the group of participants $\leq$ 74 years we did not observe significant differences. In the LD group we only observed significant benefits global cognition in older adults $\leq$ 74 years; in spatial orientation, participants $>$ 75 years achieved more significant improvements in TO and in C. In all groups, benefits were seen in both age groups, except in the SCI group, which has only found improvements in participants $>$ 75 years. Other studies applying CS found differences in visuospatial/executive functions, language skills, and memory in the 65–79 age group and the 80+ age group in healthy older adults with normal cognitive function (Park et al., 2019). In a meta-analysis study on the effect of age on global cognition in participants with MCI, the meta-regression analysis indicated that age was not significantly associated with the

effect of cognitive intervention (Li et al., 2011). In addition, Carballo--García et al. (2013) observed, a significant effect of age, in the sense that younger participants without cognitive impairment seem to benefit more from CS; however, no significant effect of age was observed in cognitively impaired participants.

According to Fernández-Ballesteros et al. (2012); the fact that younger participants had greater changes in cognitive function could be explained by now younger age is related to higher neuronal plasticity. Thus, the earlier the psychosocial non-pharmacological intervention is initiated the more likely it is that cognitive functions will be preserved (Vernooij-Dassen et al., 2010).

The study's strengths were: 1) its status as an RCT by cognitive levels and its inclusion of long-term follow-up of 12 months, and 2) the administration of a personalized and specialized CS.

4.1. Limitations

First, there was a high number of dropouts in the MD group due to forgetfulness, difficulty in locating participants, illness, and institutionalization. Second, in the MD group, the average attendance at 70% or more of the sessions was only 45.45%. In other studies, the mean attendance was between 81 and 89% (Aguirre et al., 2013; Spector et al., 2003, 2008). Third, there is an absence of studies on participants with SCI that apply CS programs to compare with the results obtained in our study. Research to date has focused predominantly on the well-established clinical stages of MCI and dementia, with a very limited literature evaluating the benefits of non-pharmacological treatments among (including CS), on older adults with subjective cognitive decline (Sikkes et al., 2021).

4.2. Futures studies

Currently, there is much evidence in the literature on the efficacy of CS in older adults with MCI and dementia. However, few studies evaluate the benefits for older adults with subjective cognitive impairment in particular. Observational studies can provide insight into whether older adults with memory problems are actively being managed differently than older adults who are cognitively healthy (Hallam et al., 2021). Therefore, future research needs to look at the benefits of CS in older adults with memory problems.

5. Conclusions

This RCT has demonstrated benefits through personalized and adapted CS for older adults of various cognitive levels in a community setting with a "short-term intervention" (the duration of the CS is less than 3 months), using fewer than 14 group sessions of 45 min each taking place once a week. These benefits could be extended to reductions in social care and other community services, as discussed by other authors (Orgeta et al., 2015).

IRB protocol/human subjects approval

Not applicable

Ethical considerations

This study was approved by the Research Ethics Committee of the Autonomous Community of Aragón, (protocol number CEICA PI11/0090 and PI11/00,091) and registered in ClinicalTrials.gov (identifies NCT03831061 and NCT04648670). All personal data protection regulations were respected. Participants were informed of the study objectives, and they signed a written informed consent form. The deontological norms recognized by the Declaration of Helsinki (52nd WMA General Assembly, Edinburgh, Scotland, October 20,020) and good clinical practice norms were followed, and the study complied with current legislation. The manuscript followed the CONSORT 2010 recommended guidelines (Schulz et al., 2010).

CRediT authorship contribution statement

Isabel Gómez-Soria: Conceptualization, Methodology, Investigation, Resources, Data curation, Writing – original draft, Project administration. **Chelo Ferreira:** Formal analysis, Investigation, Data curation, Writing – original draft. **Bárbara Oliván-Blázquez:** Writing – review & editing, Supervision. **Alejandra Aguilar-Latorre:** Formal analysis, Investigation, Resources, Data curation, Writing – review & editing. **Estela Calatayud:** Conceptualization, Investigation, Data curation, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare no conflicts of interest.

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Supplementary materials

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