Three-Month Cognitive Stimulation Intervention Through Targeted Activities in the Elderly Population with Mild Cognitive Impairment in a Primary Care Settings

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ABSTRACT

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| **Aims:** To implement an intervention that allows cognitive stimulation in patients over 60 years old with Mild Cognitive Impairment (MCI).  **Study design:** A quasi-experimental study with a pre-test and post-test design was conducted to evaluate the impact of cognitive stimulation on the elderly population with MCI. The intervention comprised structured cognitive activities and educational sessions aimed at enhancing cognitive function. It was implemented.  **Place and Duration of Study:** Ambulatory Care Medical Unit. The study was conducted from March 1st, 2024 to January 31st, 2025, with Mexican patients attending outpatient consultation of the Gerontology Speciality department (gerontological module) at the Family Medicine Clinic (FMC) "División del Norte" in Mexico City, Mexico. The data collection was from October 1st, to December 31st, 2024.  **Methodology:** Data collection was carried out using a prospective design with three questionnaires. At the beginning of the study, a sociodemographic factors questionnaire and the Montreal Cognitive Assessment (MoCA) were administered. At the end of the study, the MoCA was repeated, and the Mini-Mental State Examination (MMSE) was conducted.  **Results:** We included 31 patients with MCI. The average age was 78.84 years old (SD=8.1, median age=79 [IQR=72-85] years old). The median age was equal between females (79 years old, IQR=71-85) and males (79 years old, IQR=74.75-85, p=0.811, Median Test between independent groups). The basal MoCA score averages in a range of MCI (22.48 score; with values ranging from 20 to 25; median=22; IQR=21-24). The cognitive intervention led to statistically significant improvements in MoCA scores, with the mean increasing from 22.46 to 23.96 (p < 0.001). Males experienced a slightly greater improvement than females (final MoCA: 24.00 vs. 23.95). The proportion of participants scoring ≤22 decreased from 51.6% to 3.2% post-intervention.  **Conclusion:** Data indicates that the cognitive intervention effectively enhanced cognitive performance. Participants exhibited a clear shift towards higher cognitive scores post-intervention, with a marked reduction in lower scores and increased consistency in cognitive performance. Furthermore, the intervention proved beneficial for both male and female participants, with slight variations in cognitive gains suggesting the need for further exploration of potential sex-related differences in response to cognitive training. |

*Keywords: Elderly; mild impairment cognitive; intervention; primary care.*

1. INTRODUCTION

Mild cognitive impairment (MCI) is a prevalent condition among the elderly population (Eshkoor et al. 2015, Anand & Schoo 2024, Rueda-De-la-Rosa et al 2024) and is considered an intermediate stage between normal cognitive ageing and dementia (Rueda-De-la-Rosa et al 2024). It is characterized by deterioration of memory, complex attention, and cognitive function, and one or more of the following cognitive domains: learning, language, executive function, social cognition, and visuospatial function (Rueda-De-la-Rosa et al 2024, Eshkoor et al. 2015). Therefore, early identification is crucial for implementing interventions that may delay or mitigate its progression. In Mexico, population ageing and the increasing prevalence of non-communicable chronic diseases have heightened the burden of neurodegenerative disorders, underscoring the need for studies on MCI and its associated factors (Juarez-Cedillo et al. 2022, Razo et al. 2024). In a previous study (Rueda-De-la-Rosa et al., 2024), we established that the most predominant sociodemographic characteristics in the elderly population diagnosed with MCI were females, seventies adults, and those with a basic level of education, and with normal weight (Rueda-De-la-Rosa et al., 2024). Additionally, most common comorbidities included hypertension, type 2 diabetes, obesity, hypercholesterolaemia, gonarthrosis, and glaucoma (Rueda-De-la-Rosa et al., 2024). Multivariate analysis identified advanced age, hypertriglyceridaemia, peptic ulcer disease, glaucoma, chronic obstructive pulmonary disease COPD, and asthma as independent risk factors for MCI, while a higher level of education emerged as a protective factor. On the other hand, several studies identified others factors associated with MCI such as sex, family history, rural residence, low education, living alone, being single, smoking, income level, a high-fat diet, and chronic diseases (Byeon 2019, Wang et al. 2020, Ribeiro et al. 2021, Hwang 2022, Rueda-De-la-Rosa et al., 2024). These findings highlight the importance of designing targeted interventions for elderly population with MCI, focusing on health education, comorbidity management, and the promotion of healthy lifestyles to mitigate the impact of cognitive decline in this population. Therefore, the objective of the study was to implement an intervention that allows cognitive stimulation in patients over 60 years old with MCI.

**1.1 The Aim of the Study**

To implement an intervention that allows cognitive stimulation in patients over 60 years old with Mild Cognitive Impairment.

**1.2 Research Question**

In patients with MCI, will cognitive stimulation help prevent the transition to more advanced stages of the disease?

**1.3 Hypothesis**

By implementing educational sessions on cognitive stimulation and targeted cognitive stimulation activities—focusing on areas such as visual and auditory function, abstraction, orientation, language, memory, and executive function—it possible to delay the progression of Mild Cognitive Impairment to more advanced stages of the disease.

2. material and methods

**2.1 Study design and settings**

A quasi-experimental study with a pre-test and post-test design was conducted to evaluate the impact of cognitive stimulation on the elderly population with MCI. The intervention comprised structured cognitive activities and educational sessions aimed at enhancing cognitive function and therefore delaying disease progression. It was implemented with Mexican patients attending outpatient consultation of the Gerontology Speciality department (gerontological module) at the Family Medicine Clinic (FMC) "División del Norte" in Mexico City, Mexico. Data collection was carried out using a prospective design with three questionnaires. At the beginning of the study, a sociodemographic factors questionnaire and the Montreal Cognitive Assessment (MoCA) were administered. At the end of the study, the MoCA was repeated, and the Mini-Mental State Examination (MMSE) was conducted. The data collection was from October 1st, to December 31st, 2024. The study was conducted from March 1st, 2024 to January 31st, 2025.

**2.2 Study Population, Selection criteria, Sampling Method and Data Collection**

The study population included a total of 32 patients with MCI. Of these, 30 were recruited via telephone invitation because they had participated in a previous study (Rueda-De-la-Rosa et al 2024), while the Gerontology service referred the remaining two. Two patients passed away, and only one of them completed the intervention. Consequently, a total of 31 patients were included in the statistical analysis.

Participants were selected based on the following inclusion criteria: elderly subjects of both sexes, aged 60 years old or over (attending the outpatient consultation of the gerontological module), diagnosed with MCI based on the Montreal Cognitive Assessment (MoCA). Subjects with no severe sensory impairments (e.g., profound hearing or vision loss) that would hinder participation, and who consent to participate in the intervention and sign the informed consent. Exclusion Criteria were as follows: patients with moderate or severe dementia, subjects with psychiatric or neurological conditions (e.g., advanced Alzheimer's disease, major depression) that could interfere with participation, and those adults with physical disabilities preventing engagement in the activities.

We used a known sample of patients recruited by telephone after their participation in a previous study that employed intentional sampling (Rueda-De-la-Rosa et al., 2024).

Clinical and demographic data will be collected prospectively, including age, sex, weight, height, body mass index, occupation, education level, and comorbidities such as type 2 diabetes, systemic arterial hypertension (SAH), hearing loss, hypothyroidism, chronic obstructive pulmonary disease (COPD), knee osteoarthritis, gastro-oesophageal reflux disease (GERD), ischaemic heart disease (IHD), glaucoma, obesity, overweight, cancer, chronic kidney disease (CKD), nephrolithiasis, bradycardia, cerebrovascular disease, and multimorbidity. The collected data was stored in an Excel workbook, which served as the statistical database for subsequent analysis. This procedure ensured the accuracy, quality, and reliability of the extracted data, supporting the integrity of our study’s findings.

**2.3 Intervention Components and Design**

This intervention aimed to enhance cognitive function and delay the progression of mild cognitive impairment (mci) through a structured programme consisting of educational sessions and cognitive stimulation activities. Pre-intervention assessment (cognitive function evaluation using MoCA) and clinical and sociodemographic questionnaire. The first MoCA evaluation was conducted with all participants. After cognitive stimulation the post-intervention assessment were using the MoCA final evaluation and the MMSE test.

**2.3.1 Educational sessions**

The objective of the sessions was to provide participants and caregivers (a total of 21 caregivers) with essential knowledge on cognitive impairment, cognitive stimulation strategies, and lifestyle modifications. Key topics and session components are presented in Tables 1 to 3. Table 1 outlines the session plan for a cognitive stimulation intervention conducted in October.

**Table 1: Session plan for month October – cognitive stimulation intervention**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Session | Initial | Second | Third | Fourth |
| Date | (04/10/2024) | (11/10/2024) | (18/10/2024) | (25/10/2024) |
| Topic | Introduction: Cognitive Impairment | Memory | Healthy Ageing | Visuospatial Ability |
| Session content | An explanation of cognitive impairment, its diagnosis, and treatment. | A discussion on short-term and long-term memory, including the most common clinical presentations observed in patients with cognitive impairment. | An explanation of the ageing process and the essential skills for a healthy transition into later life, aimed at enhancing overall quality of life. | An explanation of visuospatial function and its role in cognitive impairment. |
| Activities | The patients introduced themselves and completed an identification form. | Patients reflected on significant memories from childhood and adulthood, followed by a paired "picture matching game” designed to enhance memory. | Patients shared experiences gained with age and categorised professions based on their fields. | Patients were given a puzzle to complete within 10 minutes, assessing accuracy and time management. |

Source: own elaboration with the results from the database.

Table 2 outlines the session plan for a cognitive stimulation intervention conducted in November.

**Table 2: Session plan for month November – cognitive stimulation intervention**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Session | Fifth | Sixth | Seventh | Eighth |
| Date | 08/11/2024 | 15/11/2024 | 22/11/2024 | 29/11/2024 |
| Topic | Executive Function | Attention | Language | Abstraction |
| Session content | An explanation of executive function and its significance in executive thinking, planning, decision-making, and problem-solving, as well as its relationship with cognitive impairment. | A discussion on attention function and strategies to enhance it. | An explanation of language as a communication tool for expressing thoughts, emotions, and ideas. | A discussion on abstract thinking, its role in cognitive function, and its connection to cognitive impairment. |
| Activities | Patients followed step-by-step instructions to create simple origami figures, evaluating their ability to follow sequences and make precise folds. The accuracy and completeness of the final origami figure were then assessed. | Patients observed an image from the manual for one minute and then described as many details as they could remember, assessing their attentional capacity. | Patients read a fragment from the children's story “the magic trunk” and were asked to create and share their endings. | Patients grouped objects and professions into appropriate categories, assessing their ability to recognise conceptual relationships. |

Source: own elaboration with the results from the database.

Table 3 outlines the session plan for a cognitive stimulation intervention conducted in December.

**Table 3: Session plan for month December – cognitive stimulation intervention**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Session | Ninth | Tenth | Eleventh | Twelfth |
| Date | 06/12/2024 | 13/12/2024 | 20/12/2024 | 27/12/2024 |
| Topic | Insomnia in elderly population | Orientation | Identification | Sensory and perceptual functions |
| Session content | An explanation of insomnia, associated causes, and sleep hygiene measures. | A discussion on the role of orientation in maintaining quality of life, along with the clinical presentation of orientation loss and its significance in cognitive impairment. | An explanation of cognitive identification skills, their role in ageing, and strategies to enhance this function. | An explanation of how sensory and perceptual functions relate to cognitive impairment. |
| Activities | No activity was conducted, as this session was added at the request of some participants. | Associations were made with historical milestones in Mexican history. Some patients connected these milestones to personal experiences from that time or to relatives who lived during those periods of Mexico’s history. | Patients submitted their favourite songs a week prior, and during the session, they identified the song title and artist when played. in addition, patients were given song lyrics with missing words and had to fill in the blanks after listening. | Patients identified flower scents (e.g., roses, hydrangeas, tulips) with closed eyes (we previously asked about allergy medical history). moreover, patients touched and identified different dry foods (e.g., almonds, coffee beans, sunflower seeds) based on texture. memory reflection: patients shared what they learned throughout the course and how they could apply it in daily life. |

Source: own elaboration with the results from the database.

Durin the last session (22/01/2025, – Second MoCA Assessment), the final MoCA evaluation was conducted (post-intervention assessment), with each patient completing the test in approximately seven minutes.

**2.3.2 Cognitive stimulation activities**

The objective was enhancing cognitive function through structured exercises targeting key cognitive domains.

**2.3.2.1 Session structure**

Frequency: one session per week.

Duration: 120 minutes per session.

Mode: group-based sessions.

Activities include:

1. Memory exercises: recall tasks, story retelling, and association games.
2. Language training: word retrieval, reading comprehension, and verbal fluency exercises.
3. Executive function tasks: problem-solving, planning activities, and decision-making scenarios.
4. Orientation tasks: calendar-based activities, spatial awareness tasks, and familiarisation with time and place.
5. Visual and auditory exercises: pattern recognition, smells, tastes, and food textures, association activities, and listening comprehension.

**2.4 Training and Standardisation**

The healthcare professional responsible for administering the MoCA assessments received training to ensure consistency and reliability in both test administration and scoring. This training, obtained via the official MoCA website, equipped them with the necessary skills to accurately evaluate multiple cognitive domains, including attention, memory, language, visuospatial abilities, executive functions, and orientation.

**2.5 Statistical analysis.**

The categorical variables are described as absolute frequency and percentage, and quantitative variables as mean, standard deviation (SD), and interquartile range (IQR). Confidence Interval 95% (CI95%) was included. Categorical variables were compared using Yates' corrected chi-square (*X2*) test and likelihood ratio, and Fisher exact test, as appropriate. Quantitative variables were compared using the Mann-Whitney U test or Student's T test as appropriate. A comparative analysis of pre- and post-test scores was performed using the paired-sample T-test to evaluate cognitive changes. A P value < 0.05 (two-tailed test) was considered significant.

**2.6 Ethical Considerations.**

The study was conducted in accordance with the Good Clinical Practice Guidelines of our laws and the Declaration of Helsinki for human experiments. The protocol was approved by two committees: The Research Committee and the Ethics Committee in Research of the FMC "División del Norte", ISSSTE (Number register A221333). A medical professional informed all participants about the study's objective, its benefits, and potential adverse events. After providing a clear explanation, the signatures of those who voluntarily decided to participate in the study were collected, ensuring that participants had sufficient time to read and sign the corresponding informed consent form. The Data was treated confidentially. To guarantee confidentiality, only the principal investigators had access to the complete dataset, including identifiable patient information (e.g., names). The patient names were replaced with unique identification numbers. The assigned number allows the data to be linked to a specific individual without revealing the individual's identity. This approach ensured that all patient data were handled under ethical standards and maintained the highest level of confidentiality throughout the study. This anonymization was conducted before sharing the dataset for statistical analysis with some researchers. After the statistical analysis, only the processed statistical data were made available to the rest of the research team.

3. results and discussion.

**3.1 Basal characteristics of the study population.**

We included 31 patients with MCI. The average age was 78.84 years old (SD=8.1, range=32, minimum age=61, maximum age=93 years old, median age=79 [IQR=72-85] years old). The median age was equal between females (79 years old, IQR=71-85, range=32 years old, minimum age=61-year-old, maximum age=93 years old) and males (79 years old, IQR=74.75-85, range=17 years old, minimum age=72-year-old, maximum age=89 years old; p=0.811, Median Test between independent groups). The mean weight of the total population was 68.45 kg (SD=10.11 kg; minimum weight=44, maximum weight=90; median=68, IQR=62-74), while the mean height was 1.59 m (SD=0.07 m; minimum height=1.4 m, maximum height=1.7 m; median=1.59, IQR=1.55-1.65). The BMI has a mean value in the overweight range (average= 27.16 Kg/m2; SD=3.14; minimum BMI=17.85 Kg/m2, maximum BMI=33.09 Kg/m2; median=27.29 Kg/m2, IQR=25.52-29.01 Kg/m2). The initial MoCA score averages in a range of MCI (22.48 score; with values ranging from 20 to 25; median=22; IQR=21-24), which is logical due to all patients having MCI. The number of comorbidities varies between 1 and 4, with a mean of 1.74 (SD=0.93). The proportion of females are higher compared to males (females=21, 67.7%, CI95% 51.6-83.9 and males=10, 32.3%, CI95% 16.1-48.4), indicating significant difference in sex distribution. The table 4 presents sociodemographic, and comorbidity data for a population divided by sex. The majority of the population is overweight (67.7%), with similar distributions between females and males. Obesity is present in at least 16% of cases, slightly more prevalent in males than females, while 12.9% of individuals have a normal weight, and underweight is rare, found only in females. Most individuals have a basic education, with comparable proportions across sexes, whereas higher education is attained by 19.4%. Employment is reported in over 55% of cases, significantly more prevalent among males than among females. The vast majority identify as Catholics, with all females and most males belonging to this group, while 3.2% follow other religions, all of whom are males. The most common comorbidities are hypertension and type 2 diabetes, with hypertension being more frequent in females than in males, while type 2 diabetes rates are similar for both sexes. Hearing loss occurs slightly more often in males than in females, whereas hypothyroidism is seen exclusively in females. Chronic obstructive pulmonary disease (COPD), gastro-oesophageal reflux disease (GORD), renal lithiasis, and bradycardia are observed at low frequencies (3.2%). A medical history of obesity and overweight is more common in males than in females. Multimorbidity is noted in all subjects, indicating that every participant possesses at least one chronic condition. These findings underscore a high prevalence of obesity, hypertension, and diabetes, alongside a notable disparity in employment between sexes, suggesting a need for targeted healthcare interventions and lifestyle modifications (table 4).

**Table 4. Sociodemographic Characteristics, and Clinical Features of the study population**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total Population  N= 31 | Females  n= 21 | Males  n= 10 |
| Underweight | 1, 3.2 (0-9.7) | 1, 4.8 (0-14.3) | 0, 0 (0-0) |
| Normal Weight | 4, 12.9 (3.2-25.8) | 3, 14.3 (0-28.6) | 1, 10 (0-30) |
| Obesity | 5, 16.1 (6.5-29) | 3, 14.3 (0-28.6) | 2, 20 (0-50) |
| Overweight | 21, 67.7 (51.6-80.6) | 14, 66.7 (47.6-85.7) | 7, 70 (40-100) |
| HE | 6, 19.4 (6.5-35.5) | 4, 19 (4.8-38.1) | 2, 20 (0-50) |
| BE | 25, 80.6 (64.5-93.5) | 17, 81 (61.9-95.2) | 8, 80 (50-100) |
| ES\* | 18, 58.1 (38.8-74.2) | 9, 42.9 (23.8-66.7) | 9, 90 (70-100) |
| CR | 30, 96.8 (90.3-100) | 21, 100 (100-100) | 9, 90 (70-100) |
| OR | 1, 3.2 (0-9.7) | 0, 0 (0-0) | 1, 10 (0-30) |
| T2D | 10, 32.3 (16.1-48.4) | 7, 33.3 (14.3-52.4) | 3, 30 (0-60) |
| Hypertension | 16, 51.6 (35.5-67.7) | 12, 57.1 (38.1-76.2) | 4, 40 (10-70) |
| HL | 5, 16.1 (3.2-32.2) | 3, 14.3 (0-28.6) | 2, 20 (0-50) |
| Hypothyroidism | 2, 6.5 (0-16.1) | 2, 9.5 (0-23.8) | 0, 0 (0-0) |
| COPD | 1, 3.2 (0-9.7) | 1, 4.8 (0-14.3) | 0, 0 (0-0) |
| Gonarthrosis | 2, 6.5 (0-16.1) | 1, 4.8 (0-14.3) | 1, 10 (0-30) |
| GORD | 1, 3.2 (0-9.7) | 1, 4.8 (0-14.3) | 0, 0 (0-0) |
| IHD | 2, 6.5 (0-16.1) | 1, 4.8 (0-14.3) | 1, 10 (0-30) |
| Glaucoma | 2, 6.5 (0-16.1) | 1, 4.8 (0-14.3) | 1, 10 (0-30) |
| HO | 3, 9.7 (0-19.4) | 1, 4.8 (0-14.3) | 2, 20 (0-50) |
| HOW | 6, 19.4 (6.5-35.5) | 3, 14.3 (0-28.6) | 3, 30 (10-60) |
| Cancer | 1, 3.2 (0-9.7) | 0, 0 (0-0) | 1, 10 (0-30) |
| CKD | 1, 3.2 (0-9.7) | 1, 4.8 (0-14.3) | 0, 0 (0-0) |
| RL | 1, 3.2 (0-9.7) | 1, 4.8 (0-14.3) | 0, 0 (0-0) |
| Bradycardia | 1, 3.2 (0-9.7) | 1, 4.8 (0-14.3) | 0, 0 (0-0) |
| Multimorbidity | 31, 100 (100-100) | 21, 100 (100-100) | 10, 100 (100-100) |

Source: Prepared by the authors using data from the database. HE= Higher Education (University and Postgraduate). BE= Basic Education. ES= Employment Status. CR= Catholic Religion. OR= Other Religion. T2D= Type 2 Diabetes. HL= Hearing Loss. COPD= Chronic Obstructive Pulmonary Disease. GORD= Gastro-Oesophageal Reflux Disease. IHD= Ischaemic Heart Disease. HO= History of Obesity. HOW= History of Overweight. CKD= Chronic Kidney Disease. RL= Renal Lithiasis. \*P value 0.020. P value was calculated by Yates Corrected Chi-Square Test, or Likelihood Ratio Chi-Square Test and Fisher exact test, as appropriate.

**3.2 Cognitive Performance Improvement Following the Intervention**

The intervention activities were selected based on the cognitive function being assessed in each session’s theme. To evaluate individual tasks, patients were given a corresponding worksheet for each activity, and a specific timeframe was allotted depending on the nature of the task. Upon completion, responses were reviewed with the patients, and any errors were corrected. The activities were conducted effectively within the planned structure, meeting the evaluation criteria, which included completion within the designated time, adherence to instructions, and accuracy of responses.

The table 5 presents the distribution of MoCA scores before and after the intervention. Initially, most participants scored between 21 and 25 points, with the highest proportion (25.8%) at a MoCA score of 21, while lower scores (20–22) accounted for 51.6%. After the intervention, there was a noticeable shift towards higher scores, with the proportion of participants scoring ≤22 decreasing from 51.6% to 3.2%, while scores of 23 points and above became more frequent, peaking at 32.3% for a score of 25 points. This improvement suggests a positive impact of the intervention on various cognitive functions, as lower scores declined and higher scores increased. Although 9.7% of participants were lost to follow-up, the remaining sample demonstrates a clear trend of cognitive enhancement, supporting the effectiveness of the intervention.

**Table 5. Distribution of MoCA Scores Before and After the Intervention**

|  |  |  |
| --- | --- | --- |
| Scores | Basal-MoCA | Final-MoCA |
| 20 | 3, 9.7% | 0, 0.0% |
| 21 | 8, 25.8% | 0, 0.0% |
| 22 | 5, 16.1% | 1, 3.2% |
| 23 | 5, 16.1% | 9, 29% |
| 24 | 6, 19.4% | 8, 25.8% |
| 25 | 4, 12.9% | 10, 32.3% |
| Dropouts | 0, 0.0% | 3, 9.7% |
| Total | 31, 100% | 31, 100% |

Source: Prepared by the authors using data from the database.

After the intervention, the final MoCA score averages was 23.96 score (SD= 0.92); with values ranging from 22 to 25; median=24; IQR=23-25). The Wilcoxon signed-rank test indicates a statistically significant difference between the basal MoCA score and the final MoCA score (p < 0.001). This result confirms a significant improvement in cognitive performance, indicating that the intervention had a measurable impact on MoCA scores. The paired-sample t-test results indicate a statistically significant improvement in MoCA scores following the intervention. The mean basal MoCA score (MoCA=22.46, SD=1.64) was lower than the mean final MoCA score (MoCA=23.96, SD=0.92) in a sample of 28 participants. The smaller standard deviation in the final MoCA scores suggests a reduction in variability, indicating that participants' cognitive performance became more consistent after the intervention. Additionally, the standard error of the mean decreased from 0.311 (basal) to 0.174 (final), further supporting the reliability of the observed improvement. These findings suggest that the intervention had a measurable and positive impact on cognitive performance. Similarly, both female and male participants experienced a statistically significant increase in MoCA scores following the intervention (p< 0.001 for all comparisons). The improvement was slightly more pronounced in male participants, as indicated by their final mean MoCA score (24.00 vs. 23.95 in females) and a narrower confidence interval. These findings suggest that the intervention had a consistent positive impact on cognitive function, regardless of sex. However, the slight differences in improvement between sexes suggests further investigation into potential sex-specific factors influencing cognitive gains. The distribution of MMS final scores indicates an overall improvement in cognitive performance among participants. The majority of participants scored between 24 and 26 points, suggesting a positive effect of the intervention. The most frequent score was 24 (38.7% of participants), followed by 25 (25.8%) and 26 (16.1%). A smaller proportion (12.9%) scored in 23 points. By examining the cumulative percentages, 55.2% of participants scored 24 or below, while 82.8% attained scores of 25 or higher, indicating that most participants achieved relatively high cognitive function levels after the intervention. Two participants (6.5%) were lost to follow-up, leaving a final sample of 29 participants for analysis. These results suggest that the cognitive intervention contributed to improved cognitive function in the majority of participants, as evidenced by the concentration of scores in the higher range (24–26). However, the absence of a control group limits the ability to definitively attribute these gains to the intervention alone. Further studies with control conditions would help clarify the extent of the intervention’s effectiveness.

**3.5 Discussion.**

**3.5.1 Study Population Characteristics**

The baseline characteristics of the included 31 patients with MCI reveal key demographic and clinical attributes. The average age of 78.84 years aligns with findings from other studies on MCI, particularly those conducted in geriatric populations in Mexico (Juarez-Cedillo et al. 2012, Juarez-Cedillo et al. 2022, Collazos-Marin et. 2023, Rueda-De-la-Rosa et al. 2024) and other countries (Palmer et al. 2008, Bai et al 2022, Manly et al. 2022, Chen et al. 2023). For instance, studies in Latin America, Spain and the United States report similar mean ages ranging from 68 to 80 years among MCI patients attending outpatient gerontological consultations (Lara et al. 2016, Pedraza et al. 2017, Clement-Carbonell et al. 2020, Manly et al. 2022). The predominance of female participants (67.7%) in this study is consistent with trends observed in America, Asia and Europe (Chen et al. 2023, Rueda-De-la-Rosa et al. 2024), where women are disproportionately affected due to longer life expectancy and greater health-seeking behaviours compared to men. Comparable studies in Mexico report female proportions of 60–70% in MCI cohorts, reinforcing this demographic pattern (Juarez-Cedillo et al. 2022, Collazos-Marin et. 2023, Rueda-De-la-Rosa et al. 2024).

The BMI data indicate that a significant proportion of the study population is overweight (67.7%) or obese (16.1%), a trend observed in other Latin American cohorts (Filozof et al, 2001). Studies in Mexico highlight higher obesity prevalence rates among elderly populations, often attributed to dietary habits and physical inactivity (Rivas-Marino et al. 2015, Barquera et al. 2020). In contrast, some studies from European cohorts show slightly lower obesity rates (~5–12%), possibly due to differences in lifestyle and public health interventions (Berghöfer et al. 2008). Notably, the prevalence of comorbidities such as hypertension (51.6%) and type 2 diabetes (32.3%) are higher compared with other epidemiological studies in Mexico (Meaney et al. 2013, Rojas-Martínez et al. 2021).

Education level serves as a significant predictor of cognitive impairment, with higher education correlating to a reduced risk of developing MCI (Vadikolias et al. 2012). This aligns with the characteristics of our study population, where 80.6% of patients possessed a basic education, while only 19.4% had received higher education. Similar founding’s are reported in Africa and Asia populations (Salah-Eldin et. 2021, Zhong et al. 2024).

**3.5.2 Cognitive Performance Improvement Following the Intervention**

The cognitive intervention led to statistically significant improvements in MoCA scores, with the mean increasing from 22.46 to 23.96 (p < 0.001). The findings reported by other studies indicate that cognitive intervention programmes enhanced overall cognitive function and specific cognitive abilities, irrespective of participants' initial cognitive status (Sanjuán et al. 2020, Xu et al. 2021). Additionally, cognitive decline was decelerated in elderly individuals diagnosed with dementia, and improvements were observed in their ability to perform daily activities (Smith et al. 2020). Concerning these benefits, the improvements persisted for periods ranging from two months to five years (Sanjuán et al. 2020).

Cognitive interventions have demonstrated efficacy in sustaining or enhancing cognitive function among older adults, regardless of their baseline cognitive level. Nevertheless, there remains a scarcity of studies that assess whether these improvements endure over the long term or transfer to other aspects of daily life. The review of Sanjuán et al., also highlights that cognitive performance varies according to sociodemographic factors and identifies key components that contribute to the effectiveness of cognitive programmes. Based on these findings (Sanjuán et al. 2020), it is crucial to develop intervention strategies that align with these criteria to optimise their positive impact on older populations.

When comparing these results with our study, we observed that cognitive interventions significantly enhanced cognitive function, as reflected in the improvement of MoCA scores. While our findings support the general effectiveness of cognitive training, they also suggest that the degree of cognitive improvement may be influenced by specific sociodemographic and individual factors. Additionally, our study underscores the necessity of long-term follow-up to determine the sustainability and broader applicability of cognitive gains in daily life. These findings are consistent with international studies that assess the efficacy of cognitive training programs. For instance, studies in Spain, the United States, and in Argentinian population have reported similar improvements of cognitive scores following structured cognitive interventions (Carcelén-Fraile et al. 2022, Smith et al. 2020, Rojas et al. 2013). This reinforces the effectiveness of such interventions in mitigating MCI symptoms across different cultural and healthcare settings.

Interestingly, the study’s results suggest that males experienced a slightly greater improvement than females (final MoCA: 24.00 vs. 23.95). This may be due to differences in baseline cognitive function, neurobiological factors, or engagement levels during cognitive exercises. However, further investigation is needed to understand the role of sex-specific variables in cognitive training outcomes. The proportion of participants scoring ≤22 decreased from 51.6% to 3.2% post-intervention, a marked improvement that underscores the intervention's impact, but, the dropout rate (9.7%) is a limitation, though it remains within the expected range for similar intervention-based studies. Novoa's review indicates that certain cognitive interventions are effective in preventing age-related memory decline in healthy elderly population. The researchers highlight that the most effective interventions are those conducted in group sessions lasting between 60 and 90 minutes. This aligns with the findings of our study, which utilised group sessions of 90 to 120 minutes (Novoa et al. 2008).

**3.6 Limitations and applications.**

This study has limitations. First, we did not include a non-cognitive intervention, which may also have a beneficial impact on cognition. Numerous studies have reported an association between the availability of social resources and a reduced risk of cognitive decline in elderly population (Novoa et al. 2008). Social integration, fostered through participation in social and leisure activities, as well as interactions with family and friends, has been shown to enhance cognitive function (Novoa et al. 2008). Additionally, the emotional support derived from these interactions further contributes to cognitive well-being. Similarly, we did not include isolated physical activity in the intervention design, which some authors argue can improve cognition for the following reasons: a) it increases perfusion and, therefore, oxygen concentration in the brain; b) it can increase neurotransmitters related to memory; and c) it decreases anxiety, which is related to decreased attention, which in turn is related to decreased memory capacity (Novoa et al. 2008). Another limitation lies in the use of psychometric tests to assess the effects of cognitive training, which presents certain drawbacks. Simply taking a test can lead to a learning effect, underscoring the need for a control group against which to compare the intervention group—an aspect we did not include. Furthermore, it is important to consider the so-called "ceiling effect," whereby individuals who achieve a high baseline score on the initial psychometric assessment have limited scope for further improvement (Novoa et al. 2008). While the results of our intervention support the efficacy of structured cognitive training in improving cognitive function, the absence of a control group and potential learning effects from repeated testing should be considered when interpreting the findings. Future research should incorporate a control group and explore additional factors, such as social engagement and non-cognitive interventions, to further refine and enhance cognitive training strategies for older adults.

4. Conclusion.

In conclusion, our data indicates that the cognitive intervention effectively enhanced cognitive performance. Participants exhibited a clear shift towards higher cognitive scores post-intervention, with a marked reduction in lower scores and increased consistency in cognitive performance. Furthermore, the intervention proved beneficial for both male and female participants, with slight variations in cognitive gains suggesting the need for further exploration of potential sex-related differences in response to cognitive training. The observed reduction in standard deviation and standard error of the mean in final scores indicates greater uniformity in cognitive performance, reinforcing the reliability of the intervention’s effects.

DISCLAIMER.

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

Consent.

A medical professional informed all participants about the study's objective, its benefits, and potential adverse events. After providing a clear explanation, the collection of the signatures of those who voluntarily decided to participate in the study, ensuring that participants had sufficient time to read and sign the corresponding informed consent form.

Ethical approval.

The protocol was approved by two committees: The Research Committee and the Ethics Committee in Research of the FMC "División del Norte", ISSSTE (Number register A221333).

References

1. Anand, S., & Schoo, C. (2024). Mild Cognitive Impairment. In StatPearls. StatPearls Publishing.
2. Bai, W., Chen, P., Cai, H., Zhang, Q., Su, Z., Cheung, T., et al. (2022). Worldwide prevalence of mild cognitive impairment among community dwellers aged 50 years and older: A meta-analysis and systematic review of epidemiology studies. Age and Ageing, 51(8). <https://doi.org/10.1093/ageing/afac173>
3. Barquera S, Hernández-Barrera L, Trejo-Valdivia B, Shamah, T., Campos-Nonato, I., Rivera-Dommarco, J. Obesity in Mexico, prevalence and trends in adults. Ensanut 2018-19. salud publica mex. 2020;62(6):682-692.
4. Berghöfer, A., Pischon, T., Reinhold, T., Apovian, C. M., Sharma, A. M., & Willich, S. N. (2008). Obesity prevalence from a European perspective: A systematic review. BMC Public Health, 8, 200. <https://doi.org/10.1186/1471-2458-8-200>
5. Byeon, H. (2019). Mild Cognitive Impairment Prediction Model of Elderly in Korea Using Restricted Boltzmann Machine. Journal of Convergence for Information Technology, 9(8), 248–253. <https://doi.org/10.22156/CS4SMB.2019.9.8.248>
6. Carcelén-Fraile, M. D. C., Llera-DelaTorre, A. M., Aibar-Almazán, A., Afanador-Restrepo, D. F., Baena-Marín, M., Hita-Contreras, F., et al. (2022). Cognitive Stimulation as Alternative Treatment to Improve Psychological Disorders in Patients with Mild Cognitive Impairment. Journal of clinical medicine, 11(14), 3947. <https://doi.org/10.3390/jcm11143947>
7. Chen, P., Cai, H., Bai, W., Su, Z., Tang, L., Ungvari, G. S., et al. (2023). Global prevalence of mild cognitive impairment among older adults living in nursing homes: A meta-analysis and systematic review of epidemiological surveys. Translational Psychiatry, 13, 88. <https://doi.org/10.1038/s41398-023-02361-1>
8. Clement-Carbonell, V., Cabañero-Martínez, M.J., Fernández-Alcántara, M., Ruiz-Robledillo, N., Escribano, S., Congost-Maestre, N., et al. (2020). Psychometric Properties Of The Spanish Version Of The Mild Cognitive Impairment Questionnaire. Research & Nursing Health, 43(3), 284-293.
9. Collazos-Marin, L.F., Velázquez-Lopez, G., & Aguilar-Salas, I. (2023). What diseases affect elderly Mexican population? Clinical and socialdemographic characteristics of patients of the psychogeriatric clinic of the National Institute of Psychiatry. Salud mental, 46(4), 201-210. <https://doi.org/10.17711/sm.0185-3325.2023.025>
10. Eshkoor, S. A., Hamid, T. A., Mun, C. Y., & Ng, C. K. (2015). Mild cognitive impairment and its management in older people. Clinical interventions in aging, 10, 687–693. <https://doi.org/10.2147/CIA.S73922>
11. Filozof, C., Gonzalez, C., Sereday, M., Mazza, C., & Braguinsky, J. (2001). Obesity prevalence and trends in Latin-American countries. Obesity reviews : an official journal of the International Association for the Study of Obesity, 2(2), 99–106. <https://doi.org/10.1046/j.1467-789x.2001.00029.x>
12. Hwang, E. J. (2022). Analysis of Factors Associated with Subjective Mild Cognitive Impairment (MCI) among Older Adults Resident in the Community. International Journal of Environmental Research and Public Health, 19(16), 10387. <https://doi.org/10.3390/ijerph191610387>
13. Juarez-Cedillo, T., Sanchez-Arenas, R., Sanchez-Garcia, S., Garcia-Peña, C., Hsiung, G. Y., Sepehry, A. A., et al. (2012). Prevalence of mild cognitive impairment and its subtypes in the Mexican population. Dementia and geriatric cognitive disorders, 34(5-6), 271–281. <https://doi.org/10.1159/000345251>
14. Juarez-Cedillo, T., Gonzelez-Figueroa, E., Gutierez-Gutierez, L., Aguilar-Navarro, S. G., Garcia-Cruz, J. C., Escobedo de la Peña, J., et al. (2022). Prevalence of Dementia and Main Subtypes in Mexico: The Study on Aging and Dementia in Mexico (SADEM). Journal of Alzheimer's disease : JAD, 89(3), 931–941. <https://doi.org/10.3233/JAD-220012>
15. Lara, E., Koyanagi, A., Olaya, B., Lobo, A., Miret, M., Tyrovolas, S., et al. (2016). Mild cognitive impairment in a Spanish representative sample: prevalence and associated factors. International journal of geriatric psychiatry, 31(8), 858–867. <https://doi.org/10.1002/gps.4398>
16. Manly, J. J., Jones, R. N., Langa, K. M., Ryan, L. H., Levine, D. A., McCammon, R., et al. (2022). Estimating the Prevalence of Dementia and Mild Cognitive Impairment in the US: The 2016 Health and Retirement Study Harmonized Cognitive Assessment Protocol Project. JAMA neurology, 79(12), 1242–1249. <https://doi.org/10.1001/jamaneurol.2022.3543>
17. Meaney, A., Ceballos-Reyes, G., Gutierrez-Salmean, G., Samaniego-Méndez, V., Vela-Huerta, A., Alcocer, L., et al. (2013). Cardiovascular risk factors in a Mexican middle-class urban population: The Lindavista Study. Baseline data. Archivos de cardiología de México, 83(4), 249-256. <https://doi.org/10.1016/j.acmx.2013.05.002>
18. Novoa, Ana M., Juárez, Olga, & Nebot, Manel. (2008). Efectividad de las intervenciones cognitivas en la prevención del deterioro de la memoria en las personas mayores sanas. Gaceta Sanitaria, 22(5), 474-482.
19. Palmer, K., Bäckman, L., Winblad, B., & Fratiglioni, L. (2008). Mild cognitive impairment in the general population: occurrence and progression to Alzheimer disease. The American journal of geriatric psychiatry: official journal of the American Association for Geriatric Psychiatry, 16(7), 603–611. <https://doi.org/10.1097/JGP.0b013e3181753a64>
20. Pedraza, O.L., Salazar-Montes, A.M.; Sierra, F.A.; Montalvo, M.C.; Muñoz, Y.; Díaz, J.M.; et al. (2017). Mild cognitive impairment (MCI) and dementia in a sample of adults in the city of Bogotá. Dementia & Neuropsychologia, 11(3), 262-269.
21. Razo, C., Lozano, R., & Gutiérrez-Robledo, L.M. (2024). La carga de la enfermedad en los adultos mayores en México, 1990-2022: tendencias y desafíos para el sistema de salud. Gaceta médica de México, 160(3), 345-356. <https://doi.org/10.24875/gmm.24000209> [Articule in Spanish]
22. Ribeiro, F. S., Teixeira-Santos, A. C., & Leist, A. K. (2021). The prevalence of mild cognitive impairment in Latin America and the Caribbean: A systematic review and meta-analysis. Aging & Mental Health, 26(9), 1710. <https://doi.org/10.1080/13607863.2021.2003297>
23. Rivas-Marino, G., Negin, J., Salinas-Rodríguez, A., Manrique-Espinoza, B., Sterner, K. N., Snodgrass, J., et al. (2015). Prevalence of overweight and obesity in older Mexican adults and its association with physical activity and related factors: An analysis of the study on global ageing and adult health. American journal of human biology : the official journal of the Human Biology Council, 27(3), 326–333. <https://doi.org/10.1002/ajhb.22642>
24. Rojas, G. J., Villar, V., Iturry, M., Harris, P., Serrano, C. M., Herrera, J. A., et al. (2013). Efficacy of a cognitive intervention program in patients with mild cognitive impairment. International Psychogeriatrics, 25(5), 825-831. <https://doi.org/10.1017/S1041610213000045>
25. Rojas-Martínez, R., Aguilar-Salinas, C. A., Romero-Martínez, M., Castro-Porras, L., Gómez-Velasco, D., & Mehta, R. (2021). Trends in the prevalence of metabolic syndrome and its components in Mexican adults, 2006-2018. Salud publica de Mexico, 63(6, Nov-Dic), 713–724. <https://doi.org/10.21149/12835>
26. Rueda-De-la-Rosa, M.R., Lopez-Hernandez, D., Herrera-Cruz M., Martinez-Meraz M., Pavon-Delgado E., Velez-Resendiz J.M., et al. (2024). Investigating the Prevalence and Determinants of Mild Cognitive Impairment in the Elderly Population at Primary Care Facilities. Curr. J. Appl. Sci. Technol, 43(9):7-19. <https://doi.org/10.9734/cjast/2024/v43i94426>
27. Sanjuán, M., Navarro, E., & Calero, M. D. (2020). Effectiveness of Cognitive Interventions in Older Adults: A Review. European journal of investigation in health, psychology and education, 10(3), 876–898. <https://doi.org/10.3390/ejihpe10030063>
28. Salah-Eldin, N.A., Mahmoud-Wahdan, M.M., Abd-ELRahman, T.T., Maher-Monier, M. (2021). The Significant Relationship between Education and Cognition among Elderly Patients at Ain Shams University Hospitals. EJGG; 8(1):1-7.
29. Smith G, Chandler M, Ball C, Crook, J., Locke, D.E.C., Fields, J., et al. Comparing Five Activities to Improve Quality of Life for Patients with Mild Cognitive Impairment [Internet]. Washington (DC): Patient-Centered Outcomes Research Institute (PCORI); 2020 Dec. Available from: https://www.ncbi.nlm.nih.gov/books/NBK595720/ doi: 10.25302/12.2020.CER.1306-01897IC
30. Vadikolias, K., Tsiakiri-Vatamidis, A., Tripsian is, G., Tsivgoulis, G., Ioannidis, P., Serdari, A., et al. (2012). Mild cognitive impairment: effect of education on the verbal and nonverbal tasks performance decline. Brain and behavior, 2(5), 620–627. <https://doi.org/10.1002/brb3.88>
31. Wang, Z., Hou, J., Shi, Y., Tan, Q., Peng, L., Deng, Z., et al. (2020). Influence of Lifestyles on Mild Cognitive Impairment: A Decision Tree Model Study. Clinical Interventions in Aging, 15, 2009. <https://doi.org/10.2147/CIA.S265839>
32. Xu, Z., Sun, W., Zhang, D., Chung, V. C., Sit, R. W., & Wong, S. Y. (2021). Comparative Effectiveness of Interventions for Global Cognition in Patients With Mild Cognitive Impairment: A Systematic Review and Network Meta-Analysis of Randomized Controlled Trials. Frontiers in aging neuroscience, 13, 653340. <https://doi.org/10.3389/fnagi.2021.653340>
33. Zhong, T., Li, S., Liu, P., Wang, Y., & Chen, L. (2024). The impact of education and occupation on cognitive impairment: A cross-sectional study in China. Frontiers in Aging Neuroscience, 16, 1435626. <https://doi.org/10.3389/fnagi.2024.1435626>