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Combined interventions in cognitive and psychological enhancement in community-dwelling older adults: a two-year follow-up

Intervenções combinadas no aprimoramento cognitivo e psicológico em pessoas idosas da comunidade: follow-up de dois anos

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Abstract

Objective
The objective of the study was to longitudinally assess the relationship between different combined interventions (stimulation, intervention, psychoeducation, and physical activity) in improving memory, attention, and executive functions in community-dwelling older adults.

Method
This is a quantitative, exploratory and longitudinal research carried out with 33 community-dwelling older adults in the community, with a mean age of 71.27 (+ 7.11) years. For that, sociodemographic measures were assessed for sample characterization, and cognitive and psychological measures were employed as performance indicators.

Results
The results, as evidenced by ANOVA, revealed that time 3 ($p < 0.01$), interference A6 ($p = 0.02$), learning curve ($p = 0.03$), and forgetting speed ($p = 0.03$) were impacted by the intervention. Regarding the time factor, only A1 ($p = 0.01$) and the learning curve ($p = 0.01$) showed significant alterations. Analysis using Z-score indicated that the combined strategy of cognitive training and psychoeducation yielded the greatest gains and effect on learning transfer.

Conclusion
The results highlighted that combined cognitive interventions may promote the enhancement of cognitive and psychological abilities.

Keywords: Aged; Cognition; Neuropsychology.

Resumo

Objetivo

O objetivo do estudo foi acompanhar, de forma longitudinal, a relação de diferentes intervenções combinadas (estimulação, intervenção, psicoeducação e atividade física) no aprimoramento da memória, atenção e funções executivas em pessoas idosas.

Método

Trata-se de uma pesquisa quantitativa, exploratória e longitudinal realizada com 33 pessoas idosas da comunidade, com média de idade de 71,27 (+ 7,11) anos. Para tanto, foram avaliadas medidas sociodemográficas para a caracterização da amostra e medidas cognitivas e psicológicas como medidas de desempenho.

Resultados

Os resultados evidenciaram pela ANOVA que o tempo 3 ($p < 0,01$), a interferência A6 ($p = 0,02$), a curva de aprendizagem ($p = 0,03$) e a velocidade de esquecimento ($p = 0,03$) foram afetadas pela intervenção. Já em relação ao momento, apenas A1 ($p = 0,01$) e a curva de aprendizagem ($p = 0,01$) sofreram alterações significativas. Na análise pelo Z-score, a estratégia combinada de treino cognitivo e psicoeducação apontou os melhores ganhos e efeito na transferência de aprendizagem.

Conclusão

Os resultados destacaram que as intervenções cognitivas combinadas podem favorecer o incremento das habilidades cognitivas e psicológicas.

Palavras-chave: *Pessoa idosa; Cognição; Neuropsicologia.*

The National Policy for the Promotion of Active Aging (Centro Internacional de Longevidade Brasil, 2015; Organização Mundial da Saúde [OMS], 2005), the increase in longevity (Confortin et al., 2017; J. M. L. Pereira, 2020), advancements in understanding the aging process (Maia et al., 2020), the rise in life expectancy, and the increase in the demographic index of older adults foster the perspective of maintaining autonomy, independence, and social participation among older adults (Mendonça et al., 2020). The process of cerebral aging may lead to a higher risk of vulnerability and dysfunctionality (Gomes et al., 2020), where several factors interfere with the performance of cognitive abilities, such as educational level, multimorbidity, and cultural aspects (Morocho Mazón et al., 2020).

There is evidence of psychological changes permeated by transformations (in the body, appearance, roles, etc.), adaptations, and changes in their skills' performance (Duarte et al., 2020). In this sense, it is possible that the perception of transformations due to aging and significant emotional processing leads older adults to have a negative self-perception regarding biological, emotional, and social changes (J. M. S. Pereira, 2020). Consequently, depressive and anxiety disorders may occur due to losses, a sense of helplessness in dealing with frustrations, guilt, and distress in this life cycle (J. M. L. Pereira, 2020).

Regarding cognitive aspects, aging may primarily be associated with a decline in executive and mnemonic functions (Tagliabue et al., 2018). According to Malloy-Diniz et al. (2013) and Malloy-Diniz et al. (2018), cognitive changes in older adults are not static and unitary, where modifications can be subtle (senescence), noticeable (mild neurocognitive disorder), or impactful (dementia processes), impacting the performance of daily activities (autonomy and independence), detectable in psychometric test data (Ribeiro et al., 2020).

Attentional ability is affected by age, the complexity of activities, and a decrease in the ability to detect external cues, resulting in a progressive decline in vigilance level, evident in below-average performance in tasks requiring attention (Raymundo et al., 2018). Memory shows greater vulnerability among older adults (Dalpubel et al., 2019; Silva et al., 2020; Souza et al., 2019),

with difficulties in storing recent information, quick retrieval, inhibition of irrelevant information (distractors), impacting mnemonic performance (Boller et al., 2017; Istoe et al., 2020; Sacramento et al., 2019).

Regarding executive skills, there is a tendency for decreased performance in cognitive processing (Paula et al., 2013; Ribeiro et al., 2020; Zelazo et al., 2004) and inhibitory control (Oliveira et al., 2018). Executive functions are directly related to the daily functioning of older adults (Kelly et al., 2014; Ribeiro et al., 2020). Among the expected changes, there is a decrease in inhibitory mechanisms, favoring external (noises, irrelevant information) or internal (thoughts) distractions (Gomes et al., 2020). A decrease in information processing and response speed is observed, especially when the task is restricted by a time limit (Ribeiro et al., 2020; Silva et al., 2020).

The cognitive decline due to age (Oliveira & Santos, 2020) emphasizes the importance of policies that promote interventions to improve or maintain cognitive function throughout life (Kelly et al., 2014; Oliveira & Santos, 2020). From the perspective of promoting active aging, interventions aimed at mitigating aggravations that could compromise autonomy and independence are necessary (Kautzmann & Zibetti, 2020).

Studies in the field of cognitive enhancement have highlighted the positive impacts of protocols and programs designed to train cognitive abilities, especially concerning immediate effects after the proposed intervention (Butler et al., 2018; Gomes et al., 2020; Martin et al., 2011; Nguyen et al., 2019a). In this sense, achieving longevity brings about an epidemiological shift and consequently an increased vulnerability risk for cognitive skill disorders, translating into higher rates of dementia-related conditions, mild neurodegenerative disorders, among others. Thus, interventions aimed at mitigating aggravations that could compromise functional capacity (autonomy and independence) are necessary, as well as reducing social and financial costs due to cognitive function decline (Naismith et al., 2010; Ribeiro et al., 2020).

Thus, there is a need for conceptual alignment concerning the types of cognitive interventions due to the low agreement in using terms to classify intervention types. The taxonomic reference adopted in this article relies on the studies by Bahar-Fuchs et al. (2013), Bahar-Fuchs et al. (2019), Batchelor and Naismith (2010), Belleville (2008), Chariglione and Janczura (2013), Chariglione et al. (2018), and Mowszowski et al. (2010).

In this direction, the combined model (physical and cognitive exercises) of intervention shows robust results in enhancing abilities such as verbal fluency, memory, and executive functions (dual-task, attention, and inhibition factor) when compared to isolated intervention (Montero-Odasso et al., 2018; Nocera et al., 2020; Raichlen et al., 2020). According to Rojo et al. (2020), engaging in physical exercise contributed to improved performance in most cognitive domains, especially in memory ability.

Regarding multimodal nature, it presents better responses with a moderate effect on global cognition (Silva et al., 2020; Yang & Krampe, 2009; Yu et al., 2016) when compared to unimodal interventions (Dorfman et al., 2014; Li et al., 2014; Montero-Odasso et al., 2018). Last but not least, is the analysis of the long-term effects of cognitive performance enhancement post-intervention. There is a limited number of studies investigating longitudinal follow-up compared to research focusing on the immediate effects of cognitive interventions.

In the studies by Nguyen et al. (2019a, 2019b), 64 studies were selected, and only 16 were related to analyzing the effectiveness of longitudinal results from cognitive intervention programs, with the follow-up interval ranging from 3 weeks to 18 months (mean duration [months] = 6.83, *SD* = 5.09). For older adults, the durability effect of cognitive intervention is robust evidence, as the

maintenance of cognitive abilities linearly impacts the maintenance of autonomy and independence (Borella et al., 2010; Neri et al., 2018).

Thus, contextualizing the importance of the constructs currently presented, as well as the longitudinal follow-up of psychological and cognitive measures in older adults, the objective of this article is to conduct a longitudinal 2-year follow-up aimed at investigating the relationship between diverse combined interventions in enhancing memory, attention, and executive functions among community-dwelling older adults, seeking to elucidate important characterizations and comparisons in these domains.

Method

This article is part of a quantitative, exploratory, and longitudinal research proposal, with systematic follow-ups every six months over a period of two years. As it is an exploratory study, the guiding question was to verify if there are associations between cognitive interventions and sociodemographic, psychological, and cognitive measures. Thus, the Memo group was compared to the Stimullus group, with one group serving as a control for the other because they were based on different cognitive interventions: The Stimullus Program comprises cognitive stimulation activities based on the encoding of visual and verbal stimuli, whereas Memo refers to a systematic mnemonic technique training.

Participants

The initial sample consisted of 33 older adults who completed the interventions, had an attendance rate equal to or higher than 75% in the proposed sessions, and participated in the five assessment moments over 24 months, according to the assessed performance measures. The mean age of the sample was 71.27 + 7.11 years (61-89). Older adults with or without cognitive impairment, residents of the Federal District (Brazil), of both genders, were included in the study. Individuals with visual, auditory, or motor deficits that impeded their understanding and execution in assessments and interventions were excluded, as well as those who underwent general anesthesia in the last six months and those with a history of psychiatric disorders, neurological diseases, alcoholism, or illicit drug use. This study was reviewed and approved by the Research Ethics Committee of the Universidade Católica de Brasília (UCB, Catholic University of Brasília), Certificate of Ethical Appreciation Presentation No. 22997419.1.0000.0029.

Instruments

The instruments will be presented as performance measures (Sociodemographic Measures, Cognitive Measures, and Psychological Measures). Sociodemographic measures will be used for a better description of the sample, cognitive measures for specific assessments of cognitive functions, and psychological measures for subjective psychological measures of mood levels, family functionality, and personal development. In addition to these measures, the instruments used for cognitive interventions followed the guidelines of Chariglione (2014), and physical and psychopedagogical interventions followed the guidelines of Sacramento and Chariglione (2019).

Sociodemographic Measures: Age; gender; educational level; marital status; profession/occupation; retirement; leisure and social activities; polypharmacy; multimorbidity; living arrangements; hobbies; and the Brazilian Economic Classification Criterion that characterized the

socioeconomic level. Data related to sociodemographic measures were constructed and organized by the authors.

Cognitive Measures: Addenbrooke's Cognitive Examination – revised version (ACE-R) for global cognition assessment (Carvalho; 2009); Rey Auditory-Verbal Learning Test (RAVLT) for assessing episodic long-term memory (Malloy-Diniz et al., 2018); Stroop (Victoria version) for checking executive functions (selective attention and inhibition factor) (Miotto et al., 2018).

Psychological Measures: Geriatric Depression Scale (GDS) (Paradela et al., 2005) for screening depressive symptoms; Beck Anxiety Inventory (BAI) (Cunha, 2001) for checking anxiety levels; Family Adaptability, Partnership, Growth, Affection, and Resolve (APGAR) for assessing family functionality (Vera et al., 2014); and the Personal Development Scale (EDEP) for assessing personal development within the five factors (Cachioni et al., 2017).

Procedure

In the methodological design, older adults were engaged in a 24-month follow-up with various interventions. Each group had different strategies, with weekly sessions with a mean duration of 90 minutes, conducted in a group setting. Assessments occurred every six months to monitor performance compared to the baseline.

The methodological design included 11 stages: (1) Recruitment/Training (NeuroCog-Idoso Project team training and recruitment of older adults); (2) Enrollment (Conversation circle and invitation for the participation of older adults in the NeuroCog-Idoso research group); (3) Assessment-I (Initial assessment in two 60-minute sessions); (4) Cognitive Intervention (Stimullus group: cognitive stimulation intervention; MEMO group: cognitive training); (5) Assessment-II (same as Assessment I); (6) Physical Activity or Psychopedagogical Intervention (Physical exercise intervention and psychopedagogical group with health education lectures); (7) Assessment-III (same as Assessment I); (8) Combined Intervention (Combined interventions – cognitive and physical – with characteristics similar to previous interventions); (9) Assessment-IV (same as Assessment I); (10) Transfer of Learning (Without intervention to analyze knowledge generalization, involving three meetings throughout the semester to mitigate sample loss); and (11) Assessment-V (same as Assessment I). Furthermore, it is noted that in stages 4 and 6, older adults were block-randomized to ensure the comparability of groups. For more intervention details and procedures, refer to the study by Sacramento et al. (2022).

Data Analysis

With the aim of understanding the longitudinal effect of these interventions on certain cognitive and psychological conditions, an exploratory analysis of the dataset was initially conducted. Subsequently, a series of analysis of variance (ANOVA) tests were performed to verify the effect of interventions. However, the statistical assumptions of normality, homoscedasticity, and independence of errors were not met. Therefore, the Z-score analysis of performance was selected to provide a clearer visualization of the impact of time and the various combinations on the analyzed variables. The R software (version 4.0) was used for the analyses, with a significance level set at $p \leq 0.05$.

Results

Initially, the results will be presented for a descriptive analysis of the sociodemographic measures using frequencies and percentages. Subsequently, comparisons between the psychological

and cognitive measures at the five different moments will be presented. Psychological and cognitive analyses will also be assessed for the impact of different intervention combinations over time, using ANOVA and percentile in the Z-score analysis.

Descriptive Analysis

According to sociodemographic data, most participants are female (81.80%), under the age of 79 (87.80%). The most common age range is 67 to 72 years, representing 42% of the total. The age group between 61 and 66 is the second most frequent (24.20%), followed by individuals between 73 and 78 years old (21.20%). The distribution of educational level was quite uneven among research participants. Nearly half (48.43%) did not complete high school. More than one-third (36.40%) completed high school but did not have a college degree. Only 12.12% have a college degree, and 3.03% started but did not finish university. Regarding marital status, 42.40% of these older adults are married, 21.20% are separated or divorced, and 6.06% are single. A considerable portion, 27.30%, are widowed. Regarding family structure, the data distribution was quite dispersed among categories. Approximately one-third (30.30%) live only with their child(ren), and 21.20% live only with their spouse. More than half (63.40%) of older adults live with two or three people.

Continuing with the sociodemographic characterization, regarding the number of children, 63.60% of participants have three or four children, with three children being the most common; those with five or more children represent 21.21% of the total. Exactly two-thirds (66.70%) of older adults are retired, classified in social grade E, according to the Economic Classification Criterion of Brazil by the Associação Brasileira de Empresas de Pesquisa (ABEP, Brazilian Association of Research Companies).

Most people in the sample (90.90%) do not participate in any social group or community center. More than half (60.60%) do not use a computer, and 72.70% of older adults reported memory loss complaints, yet a smaller percentage, around half (51.50%), indicated complaints from relatives. It is noted that, of the 24 older adults who complained of memory loss, only 13 (54.17%) reported complaints from relatives; among the nine who did not infer memory loss, four (44.44%) indicated complaints from relatives. Regarding multimorbidity, just over three-quarters (75.80%) have between one and three pathologies. Six older adults (18.18%) have four or more. Only one participant has no underlying pathologies. Overall, the results range from zero to eight comorbidities. Finally, 72.80% of older adults take between two and four medications. Only seven (21.20%) take five or more medications, indicating a situation of polypharmacy.

Psychological Variables

Based on the results obtained and presented in Table 1, it is observed that the GDS variable underwent a decrease over the analyzed period. From the beginning to the end of the study, there was a reduction of approximately 34% in the observed mean. In the observed sample, most older adults were below this range, noting that current studies already indicate 5 points as suggestive of depressive symptoms.

The APGAR variable, which assesses family functioning in caring for older adults, showed a slight upward trend over time. It is observed that the increase occurred among older adults who participated in the combination of interventions containing physical activity.

Table 1
Description of psychological variables

Variable	Moment	Minimum	1st Q	Median	Mean	3rd Q	Maximum	*SD*
GDS	1	0	2	3	3.594	4	9	2.27
	2	0	1	2	2.606	4	9	2.29
	3	0	1	2	2.667	3	11	2.35
	4	0	1	2	2.485	3	10	2.36
	5	0	1	2	2.364	3	8	1.75
APGAR	1	0	6	9	7.758	9	10	2.21
	2	1	7	9	7.879	10	10	2.48
	3	0	8	9	8.303	10	10	2.26
	4	2	8	8	8.152	10	10	2.37
	5	2	8	9	8.394	10	10	2.06
EDEP	1	85	105	111	110.70	118	130	11.09
	2	91	104	108	111.90	123	136	12.62
	3	94	102	111	114.20	126	159	16.33
	4	88	108	116	115.20	126	140	13.72
	5	53	101	112	109.10	123	150	22.21
BAI	1	0	2	3	5.091	6	18	4.90
	2	0	1	4	6.000	7	25	7.14
	3	0	1	3	3.879	7	16	3.97
	4	0	2	6	7.273	11	25	7.21
	5	0	1	3	5.909	6	25	7.48

Note: APGAR: Adaptability, Partnership, Growth, Affection, and Resolve; BAI: Beck Anxiety Inventory; EDEP: Personal Development Scale; GDS: Geriatric Depression Scale; Q: Quartile.

In the BAI, which measures anxiety levels among individuals, it was found that the mean did not reach severe levels at any of the times. It is noted that, between intervention moments 4 and 5, there was a considerable decrease in values for older adults who participated in the Stimullus and psychopedagogical interventions.

In the results of the ANOVA model for the psychological variables, regarding the p-values of the different intervention combinations, it was found that there was no significant difference ($p > 0.05$), meaning that the type of intervention combination did not influence the results found in the psychological measures. Analyzing the influence of time, this was significant only for the GDS variable ($p = 0.01$), where there was a reduction in the mean of the observed values in all intervention groups. Finally, analyzing the interaction between the combination of interventions and moments, no alterations were observed, meaning that the five different intervention combinations over time did not significantly change the results found in the psychological measures ($p > 0.05$).

Cognitive Variables

The A1, A6, and A7 variables, as well as the learning curve in the Rey Auditory-Verbal Learning Test and the memory test in the ACE-R, seem to show a learning trend. In the analyses, it was possible to observe that the mean values of these variables show an increase over time. On the other hand, the Stroop Time variables (time 1, time 2, and time 3) had a decrease in the observed mean value over the five moments. An ANOVA model analysis was performed for the interventions under study to conclude whether there is indeed a difference between the means of the variables according to each type of intervention.

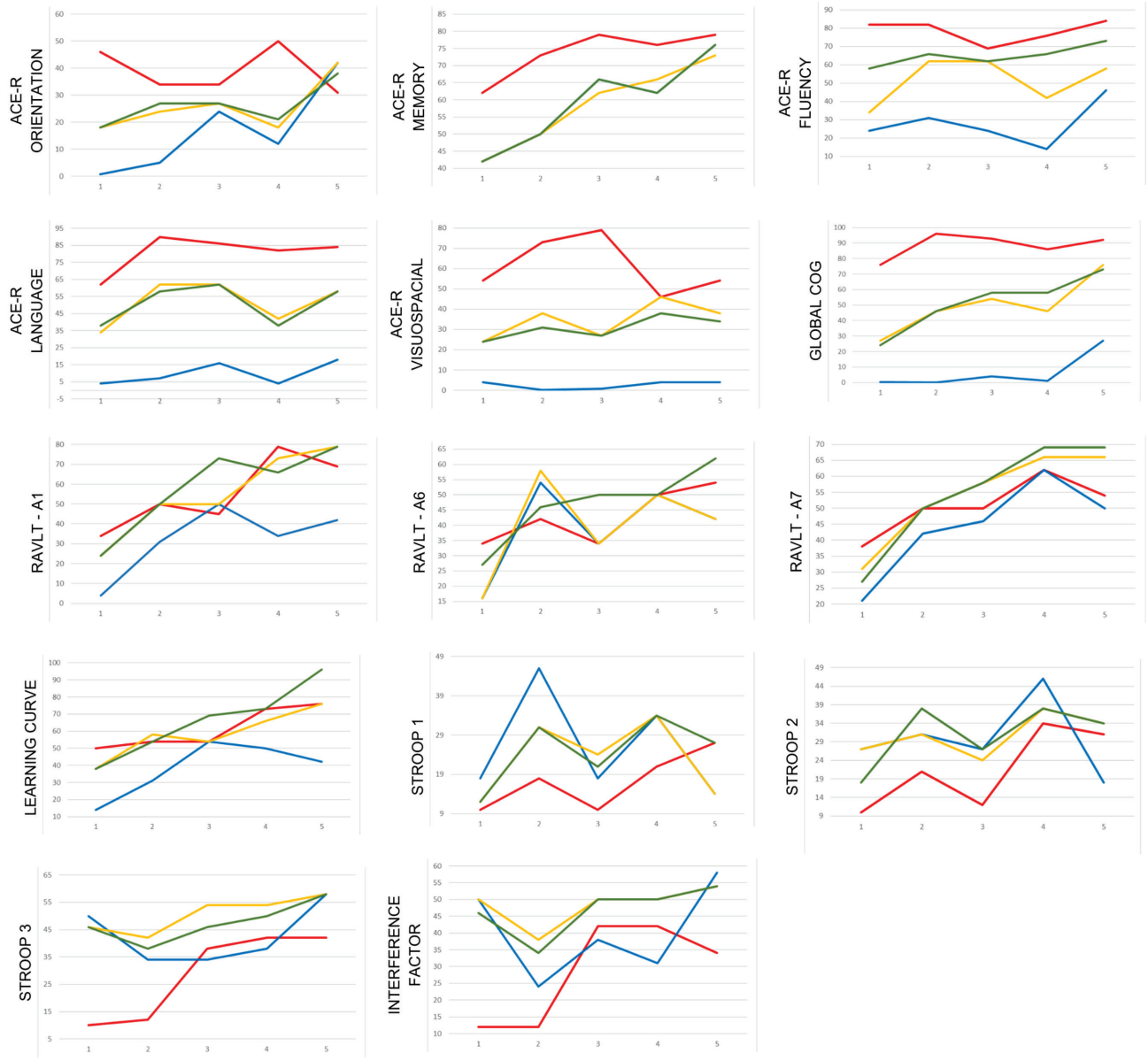
Analyzing the combined intervention in cognitive variables, it was noted that time 3 ($p < 0.01$), interference A6 ($p = 0.02$), learning curve ($p = 0.03$), and forgetting speed ($p = 0.03$) were affected by the intervention. Regarding time, only A1 ($p = 0.01$) and the learning curve ($p = 0.01$) underwent significant

changes. However, when combining the moment with the combined intervention, it can be observed that none of the cognitive measures were altered by this combination ($p > 0.05$). Finally, concerning the combined intervention, it is noticed that the only variables that follow homoscedasticity are A7 ($p = 0.21$), REC ($p = 0.11$), Memory ($p = 0.33$), Fluency ($p = 0.35$), ACE-R ($p = 0.11$), and MEEM ($p = 0.25$). No variable passed the normality test.

In order to verify performance improvement (even visually), the analysis using the Z-score was still used, which allows verification of performance and classification by percentile (Miotto et al., 2018). In the statistical analysis, it was not evidenced, but when observing performance by percentile, an increase is observed for all combinations, in global cognition, learning curve, mental flexibility, interference factor, as can be seen in Figure 1.

Figure 1

Measures of global cognition, learning curve, mental flexibility and interference factor



According to Figure 1, for memory measures (RAVLT), mental flexibility (Stroop 3), and inhibition factor (Interference), older adults who underwent the combined cognitive training and psychoeducation intervention (MEMO+Psycho) showed the best results, even in learning transfer, after six months without intervention. On the other hand, the combination of cognitive stimulation and psychoeducation (Stimullus+Psycho) demonstrated more discreet gains in the performance of older adults, and for delayed memory (A7) and learning curve, there was a decrease in the learning effect, where knowledge did not sustain during the intervention-free period. Regarding attention (selective and divided), Stroop 1 and 2, there was no transfer of learning by any of the combinations, observing a decrease in performance after six months without cognitive intervention. For global cognition measures, it is observed that the Stimullus+Psycho combination presented the lowest results over time, but with a slight gain in learning transfer.

Discussion

From these results, there's an observed reduction of approximately 34% in the GDS mean, according to the variance analysis. The high prevalence of depressive symptoms in older adults may be related to cognitive deficits and predict dementia (Lima et al., 2020). The benefits of cognitive intervention on psychological measures, such as depression and anxiety, are supported by studies showing a significant decrease in depressive symptomatology (Souza et al., 2019) and improvement in overall cognitive performance (Casemiro et al., 2016; J. M. L. Pereira, 2020).

The strategy of cognitive intervention (Souza et al., 2019), combined (Nocera et al., 2020), and psychopedagogical (Galvão & Sousa, 2020) interventions, focusing on improving cognitive performance, significantly impacts the autonomy and independence of older adults. The development of these activities involves the creation of new learnings, concepts, and cognitive strategies, facilitating the process of brain plasticity and improving overall cognition (Casemiro et al., 2016; Souza et al., 2019). It corroborates that cognitive intervention reduces symptoms of depression and anxiety, promotes prevention or reduction of overall cognitive decline, and enhances autonomy and independence.

Beyond these points, the socialization environment provided by interventions mitigates isolation situations and favors the establishment of new positive affective bonds (Galvão & Sousa, 2020; Irigaray et al., 2012). Participation in group cognitive interventions may have contributed to the reduction in GDS, given that 90.9% (30) of older adults did not attend any group activity.

The combined cognitive intervention adopted in this study showed beneficial effects on cognition, as per the systematic review by Sacramento and Chariglione (2019), which analyzed 99 studies and pointed to positive effects of multimodal combined interventions. Some studies did not reveal a significant difference between combined and cognitive interventions in overall cognition and in all cognitive domains (Zhu et al., 2016).

For cognitive measures, the results showed a significant effect on performance in alternate attention, mental flexibility (Stroop 3), inhibition, and cognitive processing speed (interference factor), short-term memory (RAVTL - A6), and memory learning curve. Combined interventions, which used cognitive training and psychopedagogical activities (MEMO+Psycho), provided better results for mnemonic measures, followed by the cognitive training and physical activity group (MEMO+AF).

The presence of cognitive training in combined interventions aligns with studies where this type of cognitive intervention favors improvements in cognitive function, as well as in executive function and processing speed in older adults (Kelly et al., 2014; Yang et al., 2019). The intervention using cognitive training provides, in addition to memory skills, specific benefits observed in results for executive functioning tasks (Ribeiro et al., 2020; Souza et al., 2019).

Successful performance in daily activities, especially Instrumental Activities of Daily Living (IADLs), has a direct relationship with intact executive functions (Gross et al., 2012), influencing problem-solving, cognitive flexibility, related to cognitively demanding daily tasks (Ribeiro et al., 2020). Performance in Activities of Daily Living (ADLs) and IADLs is an indicator, along with cognitive skills, of active aging and the quality of life of older adults (Gomes et al., 2020).

The increase in the memory learning curve reinforces the construct that older adults maintain the ability to learn new information and, especially, to allocate attentional, executive, and mnemonic strategies, enhanced by cognitive intervention in daily activities (Gomes et al., 2020; Sacramento et al., 2021). Immediate memory variables (A1), which have a direct correlation with the attentional system and overall memory, showed a significant trend of growth over time, regardless of the type of intervention older adults underwent.

The impact of using psychoeducation on cognitive skills, based on fostering educational spaces that empower older adults with information about aging, is referenced by some studies (Galvão & Sousa, 2020; Gomes et al., 2020; Lopes et al., 2017; Souza et al., 2019). In this sense, the participation of older adults in psychopedagogical activities in this study may have provided a space for listening, exchanging knowledge, and an opportunity for reflection in a group context, which allowed for 'experiencing' hypotheses and, especially, reflecting on reality. In other words, the use of this strategy in combined intervention articulated with pedagogical practice, which gave older adults the necessary information, also making them protagonists in the self-care process, which may have had an impact on the positive results, especially in learning transfer (between moments 4 and 5).

Most of the positive effects of cognitive interventions reported in the literature refer to cognitive performance assessed immediately after the intervention, i.e., immediate effects (Martin et al., 2011; Nguyen et al., 2019b). The most important challenge is to understand the behavior of long-term learning transfer, whether the taught and trained strategies reverberate in daily activities even without 'formal training.' The weak evidence effect of lasting cognitive gains after the end of cognitive intervention could be a point that weakens cognitive enrichment (Salthouse, 2006) and aspects of prevention and promotion of cognitive health among older adults.

One of the assumptions of this study was precisely to investigate learning effects over time. As pointed out, there was an improvement in performance for some cognitive abilities, especially global cognition, language, verbal fluency, memory, and executive function, regardless of the type of combination performed. The study by Heffernan et al. (2019) demonstrated the long-term efficacy of cognitive skills, where gains were maintained, after intervention, for 10 years regarding the subjects' reasoning and processing speed and at least 5 years for memory, with reinforcement sessions at intervals of 1 to 3 years. Other studies indicate the durability of gains for other cognitive domains, such as memory, attention, processing speed, and mental flexibility (Bunketorp-Käll et al., 2017; Sattari et al., 2020; Yang & Krampe, 2009).

This result may have been favored due to reinforcement meetings held at three moments over six months, which aligns with studies that observed the durability effects of reinforcement sessions (Felix et al., 2020).

Conclusion

The results highlight and support the premise that community-dwelling older adults can benefit from cognitive interventions. The proposed combined intervention highlighted that older adult who participated in interventions with cognitive training and psychoeducational strategies obtained the best gains and learning transfer.

In this sense, beyond training specific cognitive abilities, the data indicated possible engagement in leisure, mental, physical, and social activities that can interfere with cognition and act as protective factors that reduce the risk of dementia and cognitive impairment. The addition of reinforcement sessions in cognitive interventions is a noteworthy point that may favor learning transfer over time.

Among the study's limitations and weaknesses, the sample size (N = 33) was a limitation since, over the course of the two-year follow-up, there was a significant sample loss. Future studies with a larger sample can contribute to confirming the results obtained in this research, as well as investigating learning transfer beyond cognitive measures, incorporating participation in ADLs and IADLs.

A considerable challenge for future studies is to implement combined cognitive intervention in the public health system, especially in primary health care, and analyze both psychological and cognitive measures, as well as the frequency with which older adults use the service, the number of falls and complaints, and mainly the social participation of older adults in their communities. It also stands out that, in terms of public policies focused on active aging, this study presents a feasible program to be implemented on a larger scale, aiming at health promotion and prevention of losses (decline and dementia processes) through the promotion of cognitive reserve.

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