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Cognitive Memory Training with Healthy Elderly: Meta-Analysis and Comparison of Strategies

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ABSTRACT – Memory training is an alternative for cognitive improvement with elderly, currently evidenced in Brazilian research. Nevertheless, there is no verification of the differences between types of training, in order to identify the effectiveness of different strategies in intervention. Therefore, this paper seeks to compare strategies adopted in the Brazilian context. A meta-analysis was carried out, evaluating the effect size, publication bias and heterogeneity of the studies. The results indicate a statistically insignificant effect from insignificant to moderate on the worked memory subsystems, although with a moderate and significant effect on incidental memory. The presence of bias in publications and high heterogeneity between studies are indicated. Subsequent meta-analyses should associate the results with methodological characteristics of the works.

KEYWORDS: memory, aging, elderly, cognitive training

Treino Cognitivo de Memória com Idosos Saudáveis: Metanálise e Comparação de Estratégias

RESUMO – O treino cognitivo é um recurso possível para o aprimoramento da memória. Este trabalho busca comparar a eficácia de estratégias de treino de memória com idosos adotadas no contexto brasileiro. Pesquisou-se por estudos que apresentassem ensaios clínicos sobre efeitos de diferentes estratégias de memorização com idosos brasileiros. Realizou-se uma metanálise do tamanho de efeito (*g* de Hedges) das estratégias de nove estudos que resultaram com essas características. Evidenciaram-se efeitos do treino de insignificantes a moderados, mas não estatisticamente significativos, sobre as memórias de trabalho, episódica e semântica, além de moderado e significativo sobre a memória incidental. Isso indica que estudos brasileiros têm apresentado programas de treino com estratégias de memorização com efeito no máximo moderado sobre a memória de idosos.

PALAVRAS-CHAVE: memória, envelhecimento, idosos, treino cognitivo

Cognitive decline in aging corresponds to a simultaneously individual and public health problem, in which the drop in performance on tasks is evidenced as a physiological consequence and, when more far-reaching, a predictor of neurocognitive disorders and/or impairment of functionality (Salmazo-Silva & Lima-Silva, 2018). Recognizing, preventing or recovering cognitive deficits with the elderly, as well as improving normal performance, becomes relevant to public health in light of data on demographic aging. Specifically in Brazil, the number of elderly people reached 28 million in 2017, from 10.7 million in 1991 (Brazilian Institute of Geography and Statistics [IBGE], 2019), an increase that follows the global aging trend (Lopes & Argimon, 2016).

Different types of interventions, such as cognitive stimulation and rehabilitation, can be non-pharmacological instruments to achieve these goals, being applicable to both healthy and cognitively impaired elderly people, compensating for deficits or stimulating the recovery of cognitive performance, achievable due to neuroplasticity (D'Antonio et al., 2019). One of these intervention possibilities has also been the application of cognitive memory training (Brum & Yassuda, 2015).

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According to Gates et al. (2011), training prioritizes instructing the performance of specific cognitive skills (such as episodic memory, addressed by the authors), working on strategies such as imagination, categorization and listing, which improve performance or compensate for underperformance in that role. It differs from cognitive stimulation, which works on tasks requiring multiple cognitive domains, and from rehabilitation, which proposes global readaptation (Yassuda & Brum, 2015).

Reviews have been carried out that synthesize the findings of Brazilian research on the improvement of cognitive performance in training with the elderly (e.g., Santos & Flores-Mendoza, 2017; Souza et al., 2017). Although these studies show the improvement in performance with training, indicated by the statistical significance of the measurements, the reviews do not indicate the magnitude of this improvement, nor if there are differences in the results obtained according to the type of cognitive training strategy adopted. In view of this, the objective of this work is to investigate the magnitude of the improvement in mnemonic performance obtained through cognitive training and verify whether this magnitude differs according to the training strategy used.

METHOD

A meta-analysis of the Brazilian production on cognitive memory training with the elderly was carried out. From January to April 2020, studies were searched in the online databases SciELO.org, SciELO.br, BVS, PubMed and PsycNet. The filters "*Texto completo*" ("Full text") e "*Ensaio clínico*" ("Clinical trial") were used when available. In the first three indexers, we searched for: *treino cognitivo* (ou cognitive training ou *treino de memória* ou memory training) e *memória* (ou memory ou *memória de trabalho* ou *memória operacional* ou working memory ou *memória Episódica* ou episodic memory ou *memória semântica* ou semantic memory), using terms such as indices, where available. In the last ones, the terms in English were researched, as indexes, with the addition of "Brazil" or "Brazilian".

Due to space limitations and for greater exploration of the meta-analysis procedures, a systematic review was not carried out, that is, a qualitative description of the characteristics of the studies (Vieira, 2017). There are precedents in literature on memory training with older adults regarding the decision to focus on the meta-analysis, without a systematic review (e.g., Gross et al., 2012).

Article selection was based on the guidelines of *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) (Moher et al., 2009). For selection, four steps are suggested by the guidelines: a) identification and elimination of duplicates; b) screening of the remaining results; c) application of eligibility criteria; and d) inclusion of the study results of the process (carrying out the meta-analysis).

After the first stage of identifying the results and eliminating duplicates through the listing of their titles, we moved to screening, in which studies that presented interventions identified by their authors as training or stimulation with healthy elderly people were identified by reading the title and abstract and excluded.

In the eligibility stage, the works were selected according to the following criteria: a) clinical trials comparing pre- and post-test between groups; b) samples selected in Brazil, with individuals considered elderly by the authors, healthy (no cognitive alterations identified) and not institutionalized; c) memory intervention in accordance with the definition by Gates et al. (2011) of cognitive training; d) training of at least one memory subsystem, assessed separately after the intervention; e) verification of memory performance as a function of training results; f) report of the training strategies adopted. The results of this process were included in the meta-analysis (last step). Studies that worked on data from elderly people with pathologies of a cognitive nature were not considered.

As additional sources, references to reviews on training that, because they are reviews, were not included, but that resulted from the research were also included in the identification. The references went through screening, eligibility and inclusion steps along with the search results in the indexers.

In order to verify the magnitude of the memory enhancement or effect size, the standardized difference between the means (g of Hedges) was calculated (Lakens, 2013), combined in a random effects model (Higgins & Green, 2008), with a 95% interval of confidence (CI). Effects were classified as negligible (<0.19), small (0.20-0.49), moderate (0.5-0.8), large (0.8-1.29), or very large (>1.30) (Rosenthal, 1996). The I^2 was used to calculate the heterogeneity of the studies, classified as non-existent (0%), low (1-25%) moderate (50-75%) or high (75%) (Higgins & Green, 2008). A funnel plot was also used to check publication bias (Sterne & Egger, 2001). The significance level adopted was $\alpha = 0.05$ and calculations were performed using the RevMan® 5.3 software.

From studies that worked on other functions, only data on memory subsystems were considered. When the productions discriminated samples of non-elderly people in addition to those of elderly people, data from the latter were used. From studies that assessed memory with different instruments, data collected by a psychometric instrument were used. When more than one instrument was adopted, data from that adopted by other studies included in the meta-analysis were considered. The effect sizes were first grouped according to the trained memory subsystem and, in this group, combined by training strategy used, in order to be able to compare the effectiveness of the adopted strategies with each of the subsystems.

RESULTS

Of the 331 results obtained from the online databases and additional sources (97 after eliminating duplicates), 21 studies on training or cognitive stimulation were obtained. Of these, 14 works were eligible, five of which were excluded for not presenting the full text or statistical data necessary for the construction of the meta-analysis. Figure 1 summarizes the research process.

Among the results included, four memory subsystems were worked on. The most frequent training targets were episodic and working memory, trained by at least seven and six studies, respectively. Two studies trained semantic memory and one, incidental memory. Although nine studies were included in the meta-analysis, the effect size calculation is performed for 18 memory interventions. This is justified by the fact that a single study sometimes presented more than one intervention and, therefore, more than one evaluation of changes in mnemonic performance after the training was carried out. Table 1 summarizes characteristics of the studies.

As indicated in Figure 2, the overall effect size of the 18 analyzes indicates a small, non-statistically significant effect, with $g = 0.37$, CI 95% [-0.48, 1.22], $p < 0.40$. The heterogeneity of the studies was high and significant, $I^2 = 96\%$, $p = 0.00001$.

The funnel plot (Figure 3) is asymmetric, with most studies in upper quadrants, which represents, in the RevMan® graph, the presence of low standard error values for the studies. Funnel graphs were not built for each memory subsystem individually, as none of the subsystems received more than nine interventions, the minimum number recommended for this analysis (Higgins & Green, 2008).

Combining the studies according to the trained memory subsystem, the overall (combined) effect of the episodic memory observations was moderate and non-significant, $g = 0.52$, CI 95% [-0.75, 1.79], $p = 0.42$. High and significant heterogeneity was obtained, $I^2 = 96\%$, $p = 0.00001$. The greatest significant effect occurred with the training that

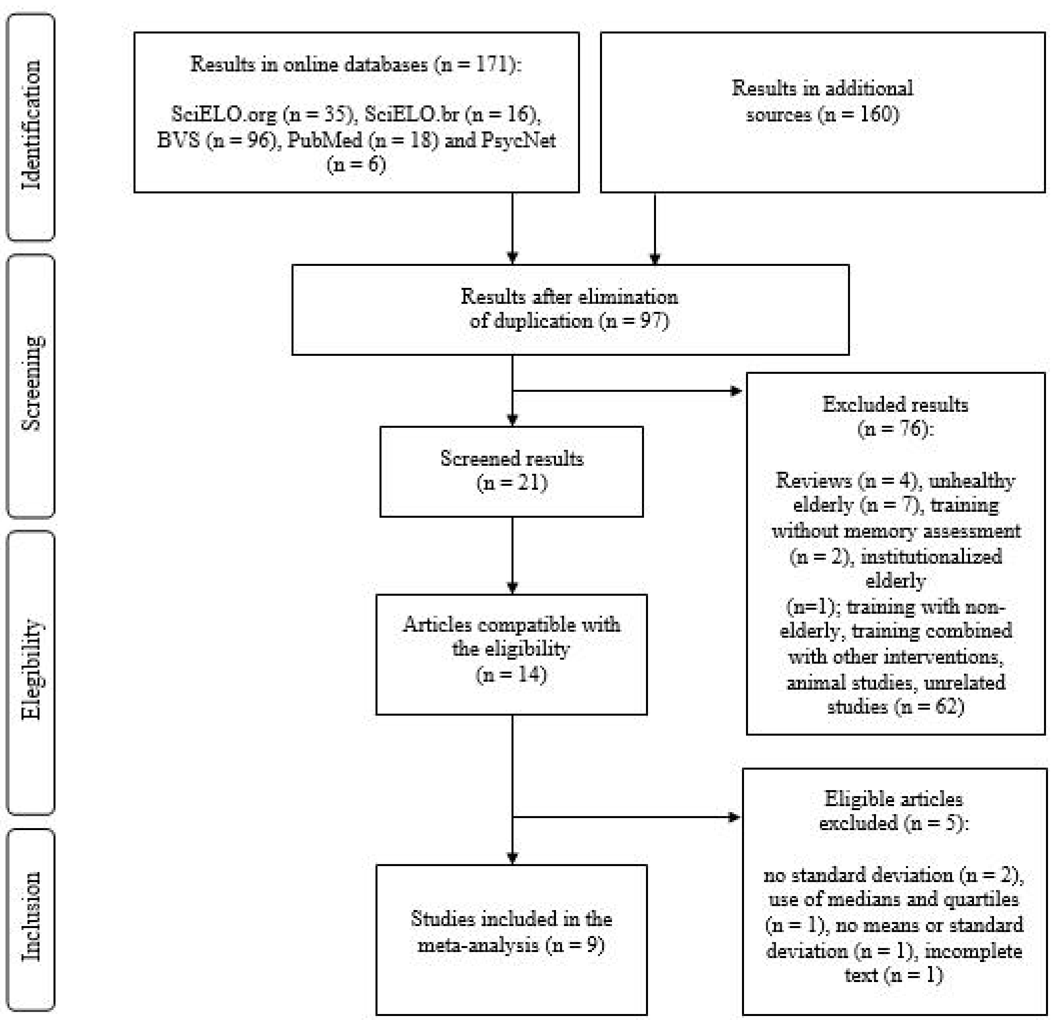

Figure 1. PRISMA Flow showing the Number of Results per Search Stage

Table 1
Characteristics of the Studies

Study	Sample Size	Number of sessions	Memory and assessment test	Training strategies	p-value (intergroups)	Hedges' g and confidence interval
Yassuda, Batistoni, Fortes e Neri (2006)	69 (GE: 35; GC: 34)	06	Episodic Memory (number of propositions recalled in two texts)	Psychoeducation, categorization and emphasis of words	0.013 [a]	3.17 [2.45, 3.89]
Salmazo-Silva e Yassuda (2009)	29 (CATG: 16; IMG: 13)	08	Episodic Memory (18-Picture Test)	Categorization	0.890	0.95 [0.17, 173]
				Imagination		-0.95 [-173, -0.17]
			Working Memory (Immediate Recall/RBMT subtest)	Categorization	0.558	0.19 [-0.54, 0.93]
				Imagination		-0.19 [-0.93, -0.54]
Carvalho, Neri e Yassuda (2010)	57 (GE: 31; GC: 26)	05	Episodic Memory (18-Picture Test)	Categorization	0.308	2.68 [1.95, 3.41]
			Working Memory (Digit Span WAIS-III subtest)		0.835	-0.62 [-1.16, -0.09]
Lima-Silva et al. (2010)	69 (GE: 37; GC: 32)	05	Episodic Memory (Delayed Recall RBMT)	Psychoeducation and imagination	0.041 [a]	1.46 [0.92, 1.99]
			Incidental Memory (Incidental Memory BCSB subtest)		0.393	0.53 [0.05, 1.01]
			Semantic Memory (Naming BCSB subtest)		0.478	0.37 [-0.11, 0.84]
Lima-Silva et al. (2011)	33 (GE: 21; GC: 12)	08	Episodic Memory (10-word recall)	Psychoeducation, categorization and repetition	NC	-0.34 [-1.05, 0.37]
			Semantic Memory (Boston Naming Test)		NC	-0.74 [-1.47, 0.00]
Irigaray, Gomes Filho e Schneider (2012)	76 (GE: 38; GC: 38)	12	Episodic Memory (Late Recall NEUPSILIN subtest)	Psychoeducation, categorization and repetition	0.118	1.52 [1.01, 2.04]
			Working Memory (Digits [asc.]/NEUPSI-LIN)		0.121	6.48 [5.33, 7.62]
Lima-Silva et al. (2012)	43 (GE: 26; GC: 17)	06	Episodic Memory (Delayed Recall/RBMT)	Psychoeducation, categorization and repetition	NC	-4.76 [-5.99, -3.54]
			Working Memory (Digit Span/WAIS-III subtest)		NC	-8.61 [-10.62, 6.61]
Golino e Flores-Mendoza (2016)	15 (GE: 7; GC: 8)	12	Episodic Memory (not assessed separately)	Visualization, face-name association and idea association	-	-
			Working Memory (Digit Span/WAIS-III subtest)		NC	3.91 [1.99, 5.83]
Lopes e Argimon (2016)	83 (GE: 45; GC: 38)	08	Working Memory (Digit Span/WAIS-III subtest)	Psychoeducation and imagination	NC	0.86 [0.41, 1.32]

Note. EG: experimental group; CG: control group; CATG: trained group with categorization; IMG: group trained with imagination. CWMS: Categorization Working Memory Span Task; NEUPSILIN: *Instrumento de Avaliação Neuropsicológica Breve NEUPSILIN*; RBMT: Rivermead Behavioral Memory Test; WAIS-III: Escala de Inteligência Wechsler para Adultos – 3ª Edição; BCSB: Cognitive Screening Brief. NC: there is no intergroup comparison (although, depending on the study, there may be an intragroup comparison between times, pre- and post-test; here the intergroup comparison is considered, as the effect size also proceeds in this type of comparison). *a*: Significant difference for the adopted significance level ($\alpha = 0.05$).

adopted together the psychoeducation, categorization and italics strategies, considered a very large effect, $g = 3.17$, CI 95% [2.45, 3.89], $p < 0.00001$. The smallest effect, among those evidenced on the experimental group, was training with psychoeducation and imagination, also considered very large and significant, $g = 1.46$, CI 95% [0.92, 1.99], $p < 0.00001$. Figure 4 presents data for episodic memory.

Among the studies that trained working memory, the effect on this construct was generally small and not significant, $g = 0.37$, CI 95% [-1.42, 2.16], $p = 0.68$. Heterogeneity was also high and significant, $I^2 = 97\%$, $p = 0.00001$. Visualization training, face-name association and association of ideas had the greatest significant effect on the subsystem (very large, $g = 3.91$, CI 95% [1.99, 5.83], $p < 0.00001$. The smallest effect

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
Carvalho, Neri e Yassuda (2010) (epis.)	3.49	0.93	31	1.42	0.49	26	6.0%	2.68 [1.95, 3.41]
Carvalho, Neri e Yassuda (2010) (trab.)	0.24	0.8	31	0.75	0.82	26	6.2%	-0.62 [-1.16, -0.09]
Golino e Flores-Mendoza (2016)	2.43	0.95	7	-0.58	0.45	8	4.8%	3.91 [1.99, 5.83]
Irigaray, Gomes Filho e Schneider (2012) (epis.)	1.08	0.75	38	0.23	0.22	38	6.2%	1.52 [1.01, 2.04]
Irigaray, Gomes Filho e Schneider (2012) (trab.)	3.34	0.63	38	0.05	0.33	38	5.7%	6.48 [5.33, 7.62]
Lima-Silva et al. (2010) (epis.)	0.92	0.75	37	0.03	0.37	32	6.2%	1.46 [0.92, 1.99]
Lima-Silva et al. (2010) (incid.)	1.38	0.54	37	1.14	0.3	32	6.2%	0.53 [0.05, 1.01]
Lima-Silva et al. (2010) (sem.)	0.03	0.06	37	0	0.1	32	6.2%	0.37 [-0.11, 0.84]
Lima-Silva et al. (2011) (epis.)	0.19	1.02	21	0.5	0.58	12	6.0%	-0.34 [-1.05, 0.37]
Lima-Silva et al. (2011) (sem.)	13.52	1.25	21	14.42	1.08	12	6.0%	-0.74 [-1.47, -0.00]
Lima-silva et al. (2012) (epis.)	0.81	0.45	26	3.26	0.58	17	5.6%	-4.76 [-5.99, -3.54]
Lima-silva et al. (2012) (trab.)	0.88	0.54	26	6.29	0.72	17	4.7%	-8.61 [-10.62, -6.61]
Lopes e Argimon (2016)	0.8	0.42	45	0.4	0.5	38	6.2%	0.86 [0.41, 1.32]
Salmazo-Silva e Yassuda (2009) (epis./CATG)	0.31	0.63	16	-0.31	0.64	0		Not estimable
Salmazo-Silva e Yassuda (2009) (epis./IMG)	-0.31	0.64	13	0.31	0.63	16	6.0%	-0.95 [-1.73, -0.17]
Salmazo-Silva e Yassuda (2009) (trab./CATG)	1.19	0.49	16	1.08	0.62	13	6.0%	0.19 [-0.54, 0.93]
Salmazo-Silva e Yassuda (2009) (trab./IMG)	1.08	0.62	13	1.19	0.49	16	6.0%	-0.19 [-0.93, 0.54]
Yassuda, Batistoni, Fortes e Neri (2006)	3.53	0.69	35	1.38	0.65	34	6.0%	3.17 [2.45, 3.89]
Total (95% CI)			**488**			**407**	**100.0%**	**0.37 [-0.48, 1.22]**

Heterogeneity: $Tau^2 = 3.00$; $Chi^2 = 431.95$, df = 16 (P < 0.00001); $I^2 = 96\%$
Test for overall effect: Z = 0.85 (P = 0.40)

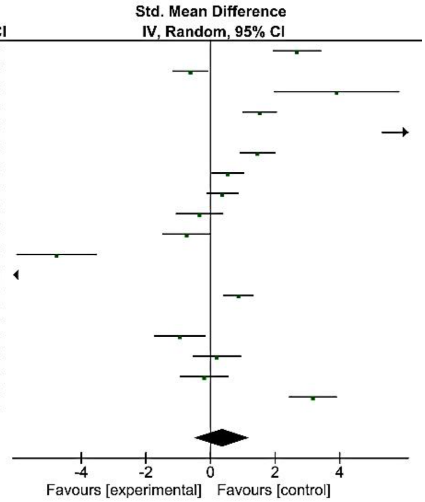

Figure 2. Effect Size (std. mean difference) of Interventions on Memory in General
Note. Size of the effect (std. mean difference) of interventions on memory, with lower and upper limits, heterogeneity (heterogeneity), mean (mean), standard deviation (SD), group size (total), tests for general effect (test for overall effect) and differences in subgroups (test for subgroup differences). On the left side of the graph, effects favoring the control group (favors control) and, on the right, the experimental group (favors experimental). Random effects model (random [effects]), with 95% CI (CI). α = 0.05. Figure, calculations and graphs generated by RevMan® 5.3.

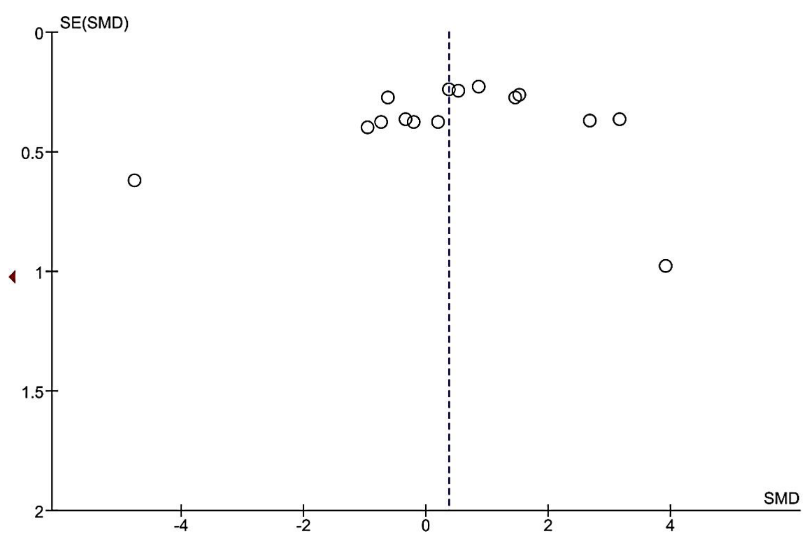

Figure 3. Funnel Plot indicating Publication Bias
Note. Funnel plot indicating publication bias, with the magnitude of the effect (standardized mean difference or SMD) on the horizontal x-axis and standard error (SE, standard error) of each study on the y-axis, vertical. Figure generated by RevMan® 5.3.

favoring the experimental group occurred with training with psychoeducation and imagination, with a large and significant effect, *g* = 0.86, CI 95% [0.41, 1.32], *p* = 0.0002. Figure 5 presents the findings.

Only one study worked incidental memory, showing a statistically significant effect considered moderate (*g* = 0.53, CI 95% [0.05, 1.01], *p* = 0.03) on the subsystem, being the only significant overall effect on the worked subsystems. Heterogeneity does not apply to a single study (Higgins & Green, 2008). The training used psychoeducation and imagination strategies only, a form of training that showed a very large and significant effect on episodic memory (Lima-Silva et al., 2010; Figure 4), considering individual studies, and a large and significant effect on working memory (Lopes & Argimon, 2016; Figure 5). Figure 6 shows the effect on incidental memory.

The greatest effect on semantic memory was small and non-significant (*g* = 0.37, CI 95% [-0.11, 0.84], *p* = 0.13), with use of psychoeducation and imagination. Only one other experiment was evidenced on the subsystem, adopting psychoeducation, repetition and categorization strategies and presenting an effect considered moderate and statistically significant, although favoring the control group, *g* = -0.74, CI 95% [-1.47, 0.00], *p* = 0.05. The overall effect on the subsystem favored the control group, being of insignificant magnitude and not statistically significant, *g* = -0.15, CI 95% [-1.23, 0.93], *p* = 0.79). Heterogeneity was high and significant, I^2 = 84%, *p* = 0.01. Figure 7 shows the findings for the subsystem.

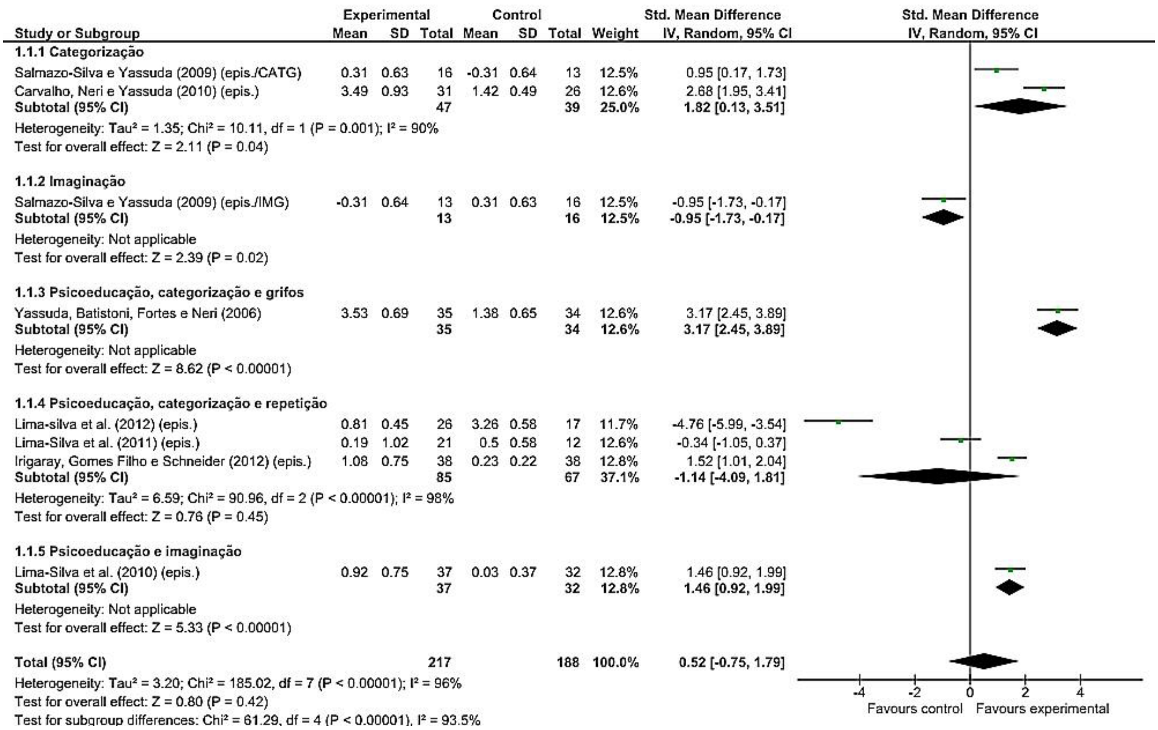

Figure 4. Effect Size (std. mean difference) of Interventions in Episodic Memory according to Adopted Strategy

Note. *Categorização*: categorization; *grifos*: emphasis of words; *imaginação*: imagination; *psicoeducação*: psychoeducation; *repetição*: repetition. Effect size (std. mean difference) of interventions in Episodic Memory memory according to the adopted strategy, with lower and upper limits, heterogeneity (heterogeneity), mean (mean), standard deviation (SD [standard deviation]), group size (total), tests for general effect (test for overall effect) and differences in subgroups (test for subgroup differences). On the left side of the graph, effects favoring the control group (favours control) and, on the right, the experimental group (favours experimental). Random effects model (random [effects]), with 95% CI (CI). α = 0.05. Figure, calculations and graphs generated by RevMan® 5.3.

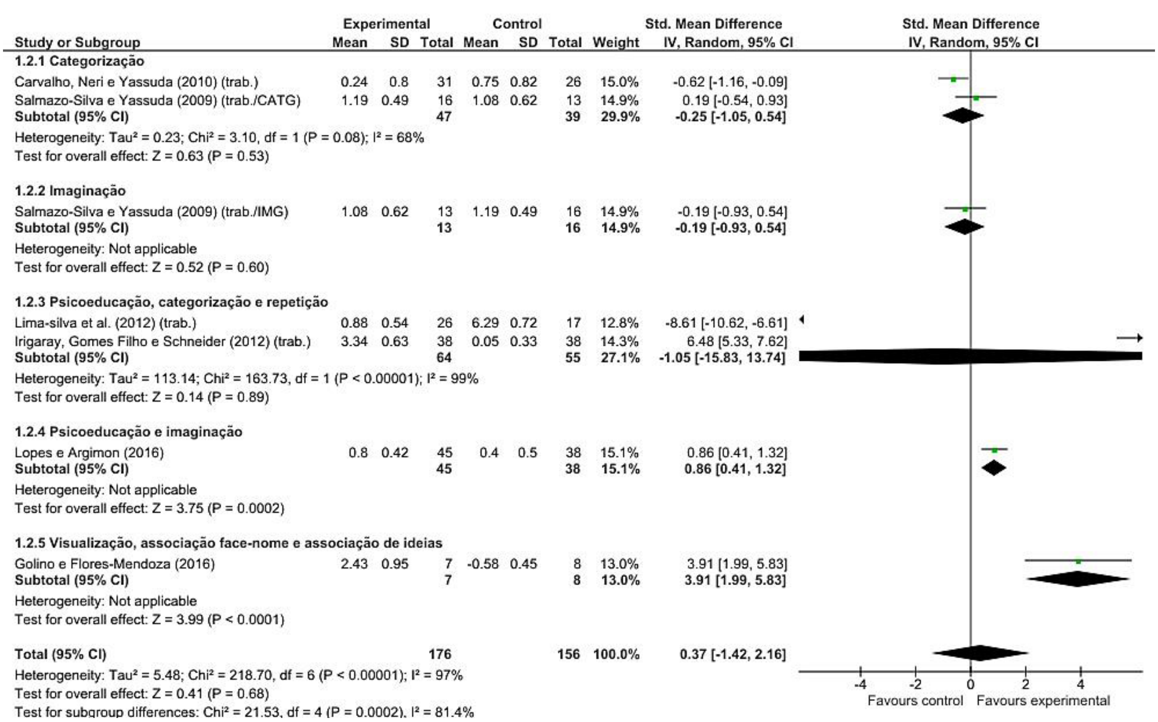

Figure 5. Effect Size (std. mean difference) of Working Memory Interventions according to Adopted Strategy

Note. *Categorização*: categorization; *imaginação*: imagination; *psicoeducação*: psychoeducation; *repetição*: repetition. Effect size (std. mean difference) of interventions in Episodic Memory memory according to the adopted strategy, with lower and upper limits, heterogeneity (heterogeneity), mean (mean), standard deviation (SD [standard deviation]), group size (total), tests for general effect (test for overall effect) and differences in subgroups (test for subgroup differences). On the left side of the graph, effects favoring the control group (favors control) and, on the right, the experimental group (experimental favors). Random effects model (random [effects]), with 95% CI (CI). α = 0.05. Figure, calculations and graphs generated by RevMan® 5.3.

One study (Golino & Flores-Mendoza, 2016), as the authors themselves claim, presented a training with tasks that worked on working memory and also with tasks focused on episodic memory. However, in the post-test evaluation, verifying the gains from the training sessions, the authors only evaluated changes in working memory, through the Digit Span subtest of the WAIS-III (Table 1), without presenting results related to episodic memory. For this reason, the study was included only among studies with training focused on working memory.

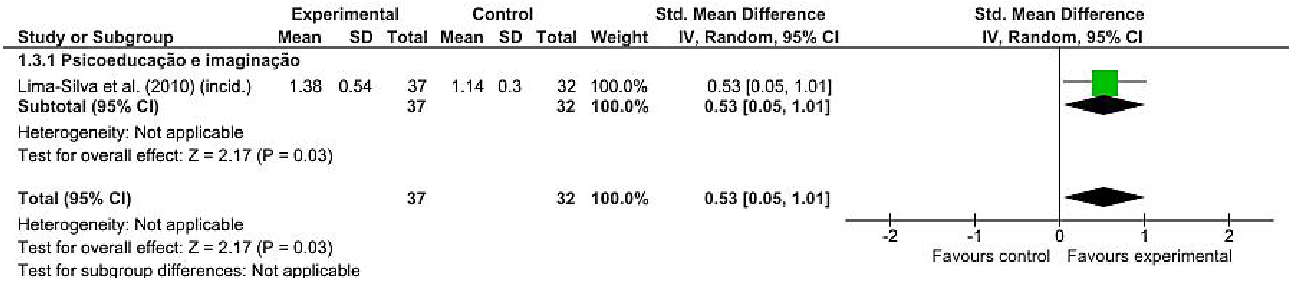

Figure 6. Effect Size (std. mean difference) of Interventions in Incidental Memory according to Adopted Strategy
Note. *Imaginação*: imagination; *psicoeducação*: psychoeducation; *repetição*: repetition. Effect size (std. mean difference) of interventions in incidental memory according to the adopted strategy, with lower and upper limits, heterogeneity (heterogeneity), mean (mean), standard deviation (SD [standard deviation]), group size (total), tests for general effect (test for overall effect) and differences in subgroups (test for subgroup differences). On the left side of the graph, effects favoring the control group (favors control) and, on the right, the experimental group (experimental favors). Random effects model (random [effects]), with 95% CI (CI). α = 0.05. Figure, calculations and graphs generated by RevMan® 5.3.

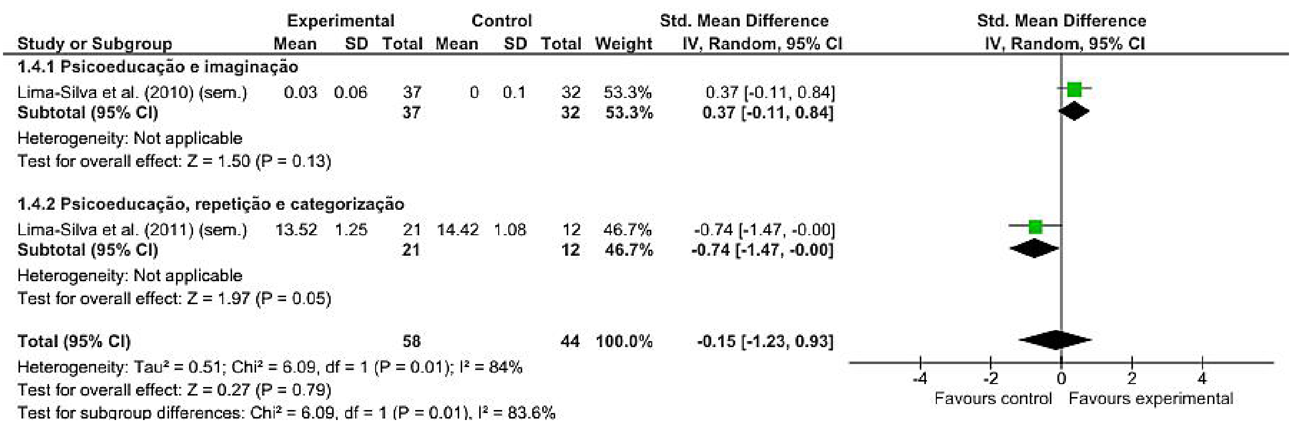

Figure 7. Effect Size (std. mean difference) of Interventions in Semantic Memory according to Adopted Strategy
Note. *Categorização*: categorization; *imaginação*: imagination; *psicoeducação*: psychoeducation; *repetição*: repetition. Effect size (std. mean difference) of interventions in semantic memory according to the adopted strategy, with lower and upper limits, heterogeneity (heterogeneity), mean (mean), standard deviation (SD [standard deviation]), group size (total), tests for general effect (test for overall effect) and differences in subgroups (test for subgroup differences). On the left side of the graph, effects favoring the control group (favors control) and, on the right, the experimental group (experimental favors). Random effects model (random [effects]), with 95% CI (CI). α = 0.05. Figure, calculations and graphs generated by RevMan® 5.3.

DISCUSSION

By highlighting the differences in effectiveness between training strategies, the synthesis of this study has the relevance of providing a referential basis for an evidence-based practice aimed at the Brazilian elderly population, as it contributes to the foundation of the best choice of training intervention (with greatest significant effect) for each memory subsystem (already worked in literature) with a part of the population.

Also, considering the profile of the study samples (healthy elderly living in Brazilian territory) and the operational definition of the interventions adopted, this framework has the potential to allow researchers and professionals to accurately identify the type of intervention for which there is evidence of efficacy in this population in literature,. This highlights the need to make data available for the construction of meta-analyses. Recent studies, such as those by Brum et al. (2020) do not specify which training strategy was used. This makes it impossible to compare with other programs according to the strategy they adopt. Still, other works do not present data necessary for effect size formulas (e.g., Almondes et al., 2017).

In this research, aspects to be considered are present from the job search process. Of the 21 studies that classify their intervention as cognitive training or stimulation, 14 fit the judicious definition of training by Gates et al. (2011). As stated, confusion between training programs and those for other interventions is common. The review by Souza et al. (2019), for example, does not differentiate between formats and concludes that "[cognitive training] has been shown to improve the cognitive performance of healthy elderly people, not only for skills trained directly during sessions, but also for other functions, such as episodic memory" (p. 508) citing, for this, at least one training study (Almondes et al., 2017) and one on cognitive stimulation (Ordonez et al., 2017). This limits the validity and generalizability of the review's findings.

The analysis of the funnel plot (Figure 2) indicated high precision of the studies (vertical axis), indicated by the low values of standard error scattered in the graph. However, there is a similar dispersion between negative and positive results (horizontal axis), indicating similarity between the number of works, individually considered, whose effect favors the control group and works whose effect favors the experimental group. Possible reasons for the occurrence of individual studies with effects favoring the control group may also be related to the methodological quality, allowing for major changes in the post-test of control groups, not explained by the intervention, but by other determining variables. Studies should be carried out to clarify the present bias.

In addition to publication bias, another measure of inconsistency is heterogeneity, which, if high, indicates that the divergence of effects between them is beyond randomly expected (Higgins & Green, 2008). Heterogeneity was high and significant for all analyses. Reasons for this may be the diversity of measures adopted by the studies to assess gains, methodological and sample differences (Pereira & Galvão, 2014). This limits the validity of the findings about the evidence synthesis, although the method of synthesis through random effects, for statistical reasons beyond the scope of this work, allows to minimize as much as possible, within the current methodological knowledge, the impact of this heterogeneity on the produced synthesis. (Borenstein et al., 2009).

The results still show a restricted amount of worked memory subsystems. Internationally, studies show the cognitive improvement of healthy elderly people in training, for example, autobiographical (Neshat-Doost et al., 2012) and prospective (Waldum et al., 2016) memories, which makes room for the possibility of realization of more Brazilian studies on other subsystems. Recent meta-analyses have pointed to an overall training effect size from small (Gross et al., 2012) to moderate (Chiu et al., 2017). The meta-analysis of the Brazilian context showed a small and non-significant general effect on memory, although, if considered separately, for example, the effect on incidental memory, the effect was moderate and significant at most.

Internationally, for working memory, there was a small and non-significant effect of cognitive training (Melby-Lervåg & Hulme, 2013), as in the Brazilian context, according to the results of this meta-analysis. Nevertheless, there are studies showing great effects in the Brazilian context, when viewed individually. For example, despite showing a small and non-significant general effect of interventions on working memory, particularly the study by Golino and Flores-Mendoza (2016) showed a significant and very large effect on the construct, adopting a training that mixes strategies of visualization, face-name association and association of ideas.

Observing those individual studies that present the greatest significant effects and favoring the experimental group, as well as considering the design of these studies and characteristics of their samples, can provide a framework for practice and research in cognitive training based on the best evidence. This, however, is also in view of the limitations of generalizing the results of clinical trials to practice, such as the risk that those assisted show similarities with the low percentage of the sample not covered by the intervention gains (Flather et al., 2006).

This research has limitations to be better elucidated in further studies. It is necessary to carry out meta-analyses that: a) verify the effects by methods other than combination by random effects, in order to seek to eliminate the possible determination of high heterogeneity on the general effects; b) associate the observed effects with data on the methodological quality of the studies, the characteristics of the designs and the profile of the samples; c) evaluate the effects of training also with samples of institutionalized elderly or with general or cognitive pathologies.

FINAL REMARKS

Based on the data presented by the meta-analysis, it is possible to conclude that the Brazilian production of cognitive training with healthy elderly people has shown: a) training programs with an effect, in general, moderate, but not significant, on episodic memory; small not significant on working memory and not insignificantly significant on semantic memory but moderately significant effect on incidental memory; b) high diversity of measurements, designs and samples between studies; c) possible bias favoring the publication of positive results of the studies; and d) that studies, when individually considered, present even very large effects on the worked constructs.

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