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Effect Of Educational Kinesiology Program On Logical Reasoning In Patients With Multiple Sclerosis

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Abstract
Background: *Multiple sclerosis (MS) is usually accompanied by cognitive impairment. Various exercises can result in cognitive improvements. The use of an educational kinesiology program training (EKPT) in cognitive rehabilitation for Multiple sclerosis is unclear.*
Aim of the study: *This study was done to investigate the effects of an educational kinesiology program on cognitive impairment in patients suffering from relapsing-remitting multiple sclerosis (RRMS).*
Material and methods*: A total of 36 patients were chosen at random from the Outpatient Clinics of two places at Cairo University: The Teaching Hospital of Kasr El Aini and the Faculty of Physical Therapy. These patients were diagnosed with mild cognitive impairment due to RRMS. The participants included 20 females and 16 males. Starting in January 2024 and continuing until May 2025. Their ages varied from eighteen to fifty. Complete clinical evaluations were conducted on all individuals utilizing RehaCom screening modules.*
Results: *in comparing among both groups, the study group showed a significant improvement in logical reasoning while control group had no significant improvement in logical reasoning.*
Conclusion*: Educational kinesiology program training is effective in improving logical reasoning in patients with RRMS with mild cognitive impairment.*
Keywords: *educational kinesiology training, cognition, relapsing remitting multiple sclerosis.*

1. INTRODUCTION:

Multiple sclerosis (MS) is a long-lasting, non-curable autoimmune neurodegenerative disease that mostly impacts the Central Nervous System. The disease affects the sensory system (85%), the motor system (hand function, 60% mobility, 63%), cognitive performance (63%), and causes fatigue (81%). [1]

Patients with MS have different clinical courses. Eighty-three percent of people diagnosed with MS have relapsing-remitting MS (RRMS), which is defined as the occurrence of acute neurological symptoms accompanied by a period of remission. [2]

One third of individuals with RRMS experience clinical degrees of cognitive impairment (CIm), according to a Systematic Review and Meta-analysis. Conforming to the Rate of Cognitive Decline in RRMS. These findings provide support to the idea that cognitive evaluations should be part of standard practice for the early diagnosis of CIm and for the identification of patients who could gain from functional and cognitive rehabilitation as part of the treatment strategy. [3] Common cognitive impairments in MS include difficulties with processing speed, working memory, attention, as well as reaction control. [4]

Treatment options for cognitive impairment in MS patients have recently been recommended as cognitive rehabilitation while cognitive behavioral therapy was suggested as treatment for depression. These two treatments require a lot of time and aren't often easy to carry out outside of large treatment centers. [5]

Educational kinesiology program is a series of simple movements intended to link the mind as well as body. It was established to improve the learning process and cognitive functioning, especially attention and memory, through definite patterns of movements [6]. Based on its founders, Educational kinesiology program activates different brain areas, with a specific concentration on the corpus callosum, enabling coaxing the two hemispheres of the brain while making them work in synchronization. Additionally, it is believed that the Educational

Kinesiology program might reorganize the brain to enhance reasoning and perception. Physical therapy with an educational kinesiology focus has shown promise in enhancing cognitive performance in the elderly. [7]
Educational kinesiology program can increase the brain blood supply and oxygenation, while simultaneously attempting to stimulate both brains. Additionally, it can improve cognitive abilities, decrease stress levels, and improve physical activity performance. [8] This study was done to examine the impact of an educational kinesiology program on logical reasoning in RRMS patients with mild cognitive dysfunction.

2. PATIENTS AND METHODS

Participants were chosen from the following locations: The Outpatient Clinic at the Faculty of Physical Therapy at Cairo University along with the Outpatient Clinic at the Teaching Hospital of Cairo University's Kasr El Aini. From the beginning of 2024 until the end of 2025, provided the consent to be a part of the study. Participating patients fulfilled the following criteria: (1) Individuals must be between the ages of 18 and 50; (2) They must have relapsing remitting multiple sclerosis (RRMS); (3) no clinical attacks through the last three-month (4) Their expanded disability status EDSS score must have been between 2.5 and 5.5 for RRMS, with a pyramidal function score below 2; (5) Their mini-mental state examination (MMSE) scores must have been between 21 and 26 (with a mild cognitive impairment); and (6) They must have adequate vision and hearing to complete the study protocol. Individuals who have a history of other neurologic impairment or disorders, as well as those who have other forms of MS, are not eligible to participate.
The participants were all evaluated utilizing the RehaCom screening modules as part of a comprehensive clinical examination.

2.1. Assessment procedure:

Specific aspect of cognitive abilities measurement:
Logical reasoning was measured by the RehaCom system.
The procedure of Logical Reasoning:
Measured the ability to continue a series and to draw logical conclusions. It examined the ability to complete logical sequences. This screening was an important part of executive function diagnostics. A visual sequence of four blocks was displayed on the screen. The patient had to complete the sequence correctly by selecting a 5th block from the options available as fast as possible. With every correct reaction and good performance from the patient, a higher level of difficulty was set. The level of difficulty the patient reached and the time taken to respond fast and correctly were assessed pre- and post-treatment. The time allowed for this test was 5 minutes for each assessment.
Treatment procedure:
1)Treatments were done at the Outpatient Clinic of the Faculty of Physical Therapy, Cairo University.
2)Treatment were conducted 3times/week, for 4 weeks.
3)The total time duration of the session for the control and the study groups was 60 min.

- **Control Group:**

Received a conventional physical therapy program, which includes:

- Upper extremities coordinative and strength training.

1- Coordinative training:
The treatment lasted for thirty minutes. After the patient's ability improved throughout exercise with 8–10 repetitions, the exercise gradually increased to a maximum of 12–15 repetitions, customized to their individual capabilities. The exercise program was given three times weekly for four weeks. The program was given in the form of:
I- Bimanual coordination:
Duration time (12) min, frequency (10:12) time & (2:3) set of repetition, (Throw the ball up in the air and handle it with the same hand, Take the ball away from the therapist and return it. Throw the ball with your right hand, then move it to your left and back, make bows with ribbons or knot shoelaces, fasten button (lap shirt), Try using different hands each time you open and close a bottle lid.
II- Hand-arm coordination:

Duration time (12) min, frequency (10:12) time & (2:3) set of repetition. (Pile building blocks, with your thumb and index finger catch a pencil and roll it between thumb and every finger. The cards should be turned over, Put the objects (buttons, paper clips, etc.) in a little container, Experiment with coloring and writing.

III- Drinking:

Duration time (6) min, frequency (10:12) time & (2:3) set of repetition (Transfer water from one container to another, place one hand on the chin, and then return it to the table.

IV-Strength training exercise:

The duration of administration was 30 minutes. Starting with 8–10 repetitions and increasing to 12–15 repetitions as the patient's ability improved throughout exercise, the number of repetitions was customized to their specific needs. The exercise program was given three times weekly for four weeks. The program was given in the form of

The following exercises: half-cobra push-ups (two minutes), shoulder press against resistance (three minutes), quadruped posture (five minutes), shifting weight in quadruped posture (five minutes), six minutes of alternating biceps and hammer curls, three minutes of resisting shoulder abduction, three minutes of resisting alternate shoulder flexion, and three minutes of resisting elbow and shoulder extension. Throughout the sessions, we will track your fatigue levels to determine the optimal amount of repetitions. The exercises were performed in a controlled way using a repetition of 10:12 for two to three sets, with a rest period of two to three minutes between each set to prevent fatigue.

Study group:

Received the Educational Kinesiology program and conventional physical therapy program, in the form of upper extremities coordinative training & strengthening exercises, as a control group.

The Educational kinesiology program was given 15 minutes per session. Exercise demonstrations were provided on the first day, and a home exercise regimen with EKP was later suggested. Two times daily, for three minutes for each exercise, with ten repetitions each set, the exercises were performed. The exercises included were the following:

I- Cross crawl

Sitting, and by the right-hand elbow touching the left knee and vice versa.

II-The owl

Put one hand up over the opposite shoulder and hold a pinch around the muscle between the neck and shoulder. The thumb should be positioned on one side of the muscle, and the other fingers should be clasped around the other side. Turn the head to the same side of the grasping hand and take a deep breath. Slowly exhale while gently bringing your head to the other side. Repeat this movement one more time.

III- The arm activation

One hand, holding the opposite arm outstretched from the back, next to the ear. To activate the muscles, take deep breath then slowly exhale while pressing one arm against the other in four different directions: front, back, in, as well as away.

IV-The Energizer

Place the head over the desk in **front**, exhale, and inhale while coming up, and try to hyperextend the neck carefully**.**

V- cook's hook-up

Place the left foot on top of the right knee. The next step is to wrap your right wrist around your left ankle. Next, place your left hand on top of your left foot's ball. Then breathe in deeply, flex your neck, and exhale.

Statistical analysis

To compare the subject characteristics between the groups, an independent-test was used. The distribution of genders among the groups was compared using a chi-squared test. The Shapiro-Wilk test was used to ensure that the data followed a normal distribution. the homogenity of variances was tested using Levene's test. To examine the effects within and between groups on the RehaCom cognitive evaluation, a mixed-design MANOVA was used. Subsequent multiple comparisons were subjected to post hoc testing utilizing the Bonferroni correction. All statistical tests were designed to have a significance threshold of $p < 0.05$. The data was analyzed using SPSS version 25 for Windows, which is a statistical tool developed by IBM SPSS in Chicago, IL, USA.

3. RESULTS

3.1. Subject characteristics:

Group A and group B pre-treatment characteristics are shown in Table (1). In terms of age, height, weight, body mass index, duration of illness, in addition to distribution of sexes, no statistically significant differences were found between the two groups ($p > 0.05$).

Table 1. Subject characteristics.

	Group A	Group B	MD	t- value	p-value
	Mean ± SD	Mean ± SD			
Age (years)	32.89 ± 8.99	34.50 ± 8.95	-1.61	-0.54	0.59
Weight (kg)	60.83 ± 9.65	59.56 ± 9.22	1.27	0.41	0.68
Height (cm)	166.17 ± 9.21	165.89 ± 10.73	0.28	0.08	0.93
BMI (kg/m²)	21.89 ± 1.83	21.52 ± 1.41	0.37	0.68	0.50
Duration of illness (years)	9.78 ± 5.87	8.67 ± 4.67	1.11	0.63	0.53
Sex, n (%)					
Females	10 (56%)	10 (56%)	$\chi^2 = 0$		1
Males	8 (44%)	8 (44%)			

SD, standard deviation; MD, mean difference; χ^2, Chi squared value; p-value, level of significance

3.2. Effect of treatment on RehaCom cognitive assessment:

Treatment and time interacted significantly (F = 123.09, p = 0.001, = 0.98). The main impact of time was statistically significant (F = 230.92, p = 0.001, =). F = 7.48, p = 0.001, = 0.75 indicates a significant main impact of treatment.

- Within group comparison

Within-group comparison revealed significant post-treatment increase in measured outcome (logical reasoning) in the study group ($p < 0.001$). (logical reasoning) did not change significantly in the control group ($p > 0.05$). (Table 2).

- Between groups comparison:

Groups did not vary significantly before treatment ($p > 0.05$). A significant improvement in logical reasoning level (ES = 1.56) and MRT (ES = 2.09) in the study group when compared to the control group ($p < 0.01$). (Table 2)

Table 2. Mean logical reasoning scores pre and post treatment of study and control groups:

	Study group	Control group			
	Mean ±SD	Mean ±SD	MD (95% CI)	P value	ES
Logical reasoning					
Difficulty level					
Pre treatment	2.17 ± 0.92	2.11 ± 0.90	0.06 (-0.56: 0.67)	0.86	
Post treatment	3.61 ± 0.98	2.17 ± 0.86	1.44 (0.82: 2.07)	0.001	1.56
MD (95% CI)	-1.44 (-1.64: –1.25)	-0.06 (-0.25: 0.14)			
	p = 0.001	***p = 0.56***			
MRT (msec)					
Pre treatment	4667.67 ± 873.88	4415.11 ± 1088.24	252.56 (-415.98: 921.09)	0.45	
Post treatment	2066.89 ± 981.10	4312.89 ± 1162.84	-2246 (-2974.77: -1517.23)	0.001	2.09
MD (95% CI)	2600.78 (2401.28: 2800.28)	102.22 (-97.28: 301.72)			
	p = 0.001	***p = 0.31***			

SD, Standard deviation; MD, Mean difference; CI, Confidence interval; p-value, Level of significance; ES, Effect size

4. DISCUSSION:

Cognitive impairment (CIm) is common in all stages of MS. It highly affects the quality of life of patients with MS. Cognitive rehabilitation is considered an important intervention and is highly recommended for MS patients with CIm. In our study, we used educational kinesiology training as a method of treatment for cognitive dysfunction in patients with RRMS who have mild cognitive impairment.

Our study revealed that there was an obvious improvement in logical reasoning in patients who received educational kinesiology training. Patients in the control group who didn't receive educational kinesiology training didn't show any improvement in logical reasoning.

Up to our knowledge there are no studies were applied to show the effect of EKP on cognition in any type of MS patients. in this study We thought that the positive results of EKP on RRMS patients' cognitive dysfunction, is due to its effect in increasing blood flow to the brain, increasing synthesis and utilization of neurotransmitters, and increasing synthesis and release of brain- derived neurotrophic factor which increase the survival of neuron and synapses especially in the hippocampus and improving neuroplasticity and cognitive process.

But there are some studies obtained the effect of EKP on cognition in some neurological diseases like stroke, Parkinsonism, dementia and elderly with mild or moderate cognitive disorders. As mentioned below.

The findings of this study support the results demonstrated by **Tammasse J.& Wahyuni S. (2016) [9]** who found that (EKPT) affects cognitive performance positively in old patients with post-ischaemic stroke.

This is also in agreement with **Anand et al., (2022) [10]**, who indicated that EKP is an effective treatment technique along with conventional physiotherapy intervention in hemispatial neglection in post stroke patients. Suggested that there was a significant improvement in outcome measures including Albert's Test, Star Cancellation Test, Single Letter Cancellation Test, Double Letter Cancellation Test, Bell's Test, Catherine Bergogo Scale and Kessler Foundation of Neglect Assessment Process.

Manik et al., (2023) [11] also indicated that the (EKPT) has a significant effect on the improvement of cognitive function in post-ischemic stroke patients when combined with music therapy.

Also **Agate G. & Varadharajulu G., (2025) [12]**, found that EKPT, which utilizes the unaffected hemisphere of the brain, significantly improved both cognitive and motor functions in individuals who have suffered a stroke. By combining sensory stimulation, bilateral exercises, and mirror box therapy and proprioceptive neuromuscular facilitation (PNF), participants had improvements in motor function, joint range of motion, sensory perception, and cognitive abilities. Intervention promoted neuroplasticity and functional recovery.

Also **Kuhn et al., (2020) [13]** stated that Kinesiology improved Parkinson's disease symptoms, cognitive abilities and execution of simple but not complex movement series. By focusing on a better interaction between the right and left brain hemisphere. Certain elongation exercises serve to integrate function of the frontal and occipital brain. Generally, it is believed that activation of the frontal lobe leads to a better stimulation of the attention intelligence.

In agreement with the present study, in their study, **Bhattad et al**., (2024) [23] found that EKPT exercises can be used in conjunction with traditional exercises to improve executive function as well as dual task performance among individuals with Parkinson's disease.By stimulating various brain regions, with a particular emphasis on the corpus callosum, facilitating inter-hemisphere communication.

Pal et al., (2025) [15] in their case study results, also provided evidence that (EKPT) helps to improve cognition and quality of life in Parkinson's disease management. By stimulating various brain regions, enhancing inter-hemispheric communication. The exercises engage multiple aspects of cognitive and physical function.

Also in line with present study, **Cheung et al., (2018) [16]** observed that, (EKPT) could be a physical activity which is recommended to improve cognitive function. (EKPT) is usually performed with music. The study examined the effects the music-with-movement intervention on the cognitive functions of people with moderate dementia stated that it improves the memory after six weeks of intervention. Music-with movement intervention may be useful for enhancing the cognitive functions of people with dementia.

Agreed with the present study **Murtadho et al., (2019) [17]** reported that EKPT can improve cognitive function in elderly people with dementia. . The positive impact of EKPT on the elderly, after 2 weeks of EKPT there has been an increase in memory function, concentration, attention, and alertness to reduce dementia. EKPT aims to maintain the optimal balance between the right and the left brain. It provides a repair stimulus to the fibers

in the corpus callosum that provide many two-way neural connections between the cortical areas of both brain hemispheres. Including several brain structures as hippocampus and amygdala**.**

This study agreed with **Mendrofa et al.,(2020) [18]** also indicated that (EKPT) can stimulate the brain by releasing stress, increasing learning concentration, clearing the mind, improving memory, and cognitive abilities such as alertness, concentration, in addition to speed in the learning process. Cognitive function in older people with dementia is positively affected by regular exercise (EKPT). EKPT improves cerebral blood flow and oxygen delivery.

Cancela et al.,(2015) [19] is in disagreement with The present study suggested that Whether EKPT is performed in isolation or combined with other exercise programs seems to have no influence on Active Older Adults' s cognitive performance.

Cancela et al.,(2020) [20] also disagreed with the present study. In their study also reported that EKPT had similar effect to standard exercise among institutionalised older adults with cognitive impairment, without any significant effect on cognitive levels, functional independence, QoL, or fitness levels. and they suggested that the lack of agreement could be due to several reasons. First, the exercise protocols were did not have a significant effect on attention or memory functions. In another study the training program combined sitting and standing exercises, whereas participants of Cancela et al., study remained in a sitting position. Second, in their study participants' mean age was higher than that reported in other study, and may have effect on participants' scope for improvement. Third, the time devoted to EKPT exercise in their study was 20 minutes, whereas EKPT sessions were considerably longer in other studies.

This study was also in disagreement with **Varela et al., (2023) [7],** who did not confirm those positive results according to their designed systematic review, in their study, according to their findings, there is no evidence that EKPT can improve cognitive as well as executive function in those who have or do not have cognitive impairment. Additionally, there was a lack of meta-analysis addressing whether EKPT had more cognitive benefits than other exercise modalities, and the studies that did exist had low to moderate confidence of evidence. For this reason, it was suggested that randomized controlled trials (RCTs) with bigger samples be performed.

5. CONCLUSION

The present study provides evidence that the educational kinesiology training program is an effective treatment for logical reasoning in mild cognitive impairment in relapsing-remitting multiple sclerosis.

This study was subjected to several limitations:

First, the short course of intervention is for 4 weeks .

Second, small sample size.

6. RECOMMENDATIONS:

Future research should be done to:

- Investigate structural changes of brain function during the application of an educational kinesiology program using diffusion tensor imaging (DTI).
- Investigate cortical activation and neural remodeling with a particular emphases on the corpus callosum, which facilitate interhemispheric communication during educational kinesiology training exercises by using quantitative electroencephalography (QEEG).

REFERENCES

- **Hassanin, M. A., Aly, M. G., Atef, H., Marques-Sule, E. & Ahmed, G.M. (2023):** Task-oriented training for upper limb functions in patients with multiple sclerosis: Systematic review and meta-analysis. Multiple Sclerosis and Related Disorders; 73: 104625.
- **Weinstock, Z. L., & Benedict, R. H. B. (2022):** Cognitive Relapse in Multiple Sclerosis: New Findings and Directions for Future Research. NeuroSci, 3(3), 510-520.
- **Wu, W., Francis, H., Lucien, A., Wheeler, T-A & Gandy, M. (2024):** The Prevalence of Cognitive Impairment in Relapsing-Remitting Multiple Sclerosis: A Systematic Review and Meta-analysis. Neuropsychol Rev.
- **Davarani, M.N., Darestani, A.A., Hassani-Abharian, P., Vaseghi, S., Zarrindast, M. & Nasehi, M. (2020):** RehaCom rehabilitation training improves a wide range of cognitive functions in multiple sclerosis patients. Applied Neuropsychology: Adult, DOI:10.1080/23279095.2020.1747070.
- **Feinstein, A. (2017):** Treatment of cognitive impairment in secondary progressive MS. Nature Reviews Neurology; 13:515–516.

- **Cano-Estrada,A.,Jimenez-Mendoza,A.,Contreras-Guerrero,D.,Hernandes-Alejandro,M. & Salas-Casas, A. (2022):** The Effect of Brain Gym on Global Cognitive Function of Institutionalized Older People. IJMHP; 24: 375-383.
- **Varela, S., Ayán, C., Bidaurrazaga-Letona,I., Carlos Diz, J.& Duñabeitia,I. (2023):** The effect of Brain Gym on cognitive function in older people: A systematic review and meta-analysis. Geriatric Nursing; 53: 175-180.
- **Lina, K. R. & Kurniawan D.P.G. (2022):** Brain Gym Exercise Gives Benefit to Improve Cognitive Function among Elderly: A Systematic Review Jurnal Ilmu dan Teknologi Kesehatan 9(2):261-271.
- **Tammasse, J. & Wahyuni, S., (2016):** Effect of brain gym on cognitive function in elderly with post ischemic stroke. Nusantara Medical Science Journal; (1), 16–24.
- **Anand, P., Mohanty, U., & Mani, S. (2022):** Brain Gym Exercises and Mirror Box Therapy in Hemispatial Neglect Post-stroke: A Randomised Clinical Trial. International journal of health sciences, 6(S4), 3580-3593.
- **Manik, M. H., Silalahi, R. D., & Tane, R. (2023).** Pengaruh Kombinasi Brain Gym Dan Terapi Musik Terhadap Fungsi Kognitif Pasien Pasca Stroke Iskemik Di Rumah Sakit Immanuel Bandung. Dinamika Kesehatan: Jurnal Kebidanan Dan Keperawatan, 14(1), 113-124.
- **Gayatri Agate, Dr. G Varadharajulu, (2025).** Effectiveness of Brain Gymnasium for Motor and Cognitive Impairments through the Unaffected Hemisphere in Post-Stroke Individuals. Journal of Neonatal Surgery, 14 (7s), 735-742.
- **Kuhn, W., Neufeld, T., & Müller, T. (2020).** Kinesiology training in patients with Parkinson's disease: results of a pilot study. Journal of Neural Transmission, 127(5), 793-798.
- **Bhattad, Radha; Gandhi, Bhavana. (2024):** Ab. No. 155 Effect of Brain Gym Exercises on Executive Functions and Dual –Task Performance in Person's With Parkinson's Disease. Journal of Society of Indian Physiotherapists 8(1): 90.
- **Pal, K., Pradhan, A., & Kaushik, N. (2025).** Abstract No: 368 Effects of Brain Gym Exercises on Cognitive Function in a Patient with Parkinson's Disease: A Case Study. Journal of Society of Indian Physiotherapists, 9(1), 118-119.
- **Cheung, D. S. K., Lai, C. K. Y., Wong, F. K. Y., & Leung, M. C. P. (2018):** The effects of the music-with-movement intervention on the cognitive functions of people with moderate dementia: a randomized controlled trial. Aging & Mental Health, 22(3), 306–315.
- **Murtadho, M. A., Ulfiana, E., & Suyatmana, S. H. (2019).** The Effectivity of Brain Gym and Memory Games Therapy for Improving Cognitive Function in Elderly People with Dementia. Indian Journal Of Public Health Research & Development, 10(9).
- **Mendrofa, F.A.M., Iswanti,D.I. & Hani,U. (2020):** efficacy of brain gym on the cognitive function improvement of people with dementia. Jurnal Keperawatan Jiwa; 8, 557 – 564.
- **Cancela, J. M., Suárez, M. H. V., Vasconcelos, J., Lima, A., & Ayán, C. (2015).** Efficacy of brain gym training on the cognitive performance and fitness level of active older adults: a preliminary study. Journal of aging and physical activity, 23(4), 653-658.
- **Cancela, J. M., Casal, Á., Sánchez-Lastra, M. A., & Ayán, C. (2020)**. Brain gym exercises versus standard exercises for institutionalised older people with cognitive impairment: A randomised controlled study. Asian Journal of Gerontology and Geriatrics, 15(1), 1-7.