Journal of Fundamentals of Mental Health

Mashhad University of Medical Sciences

Psychiatry and Behavioral Sciences Research Center

Original Article

The effectiveness of body psychotherapy on improving working memory ability and inhibition level in elementary school students

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Abstract

Introduction: The purpose of this study is to investigate the effectiveness of body psychotherapy on improving working memory and inhibition level among elementary students.

Materials and Methods: The statistical population of this clinical trial consist all elementary school students aged 7-12 years in Mashhad in 2018-19 academic year. Number of 44 students from 4 governmental schools (two boy-specific and two girl-specific schools) were selected by voluntary and purposeful sampling method and were randomized into two groups (12 boys and 10 girls in experimental group, 11 boys and 11 girls in control group). The experimental group received thirty-six 60-min sessions for 3 months during which the control group was placed on the waiting list. The measuring tools used in this study were computerized tests of working memory (N-Back) and Go no Go test. Data were analyzed using SPSS software and independent t-test.

Results: The results showed that students in the experimental group had better performance in than control group in the components of the number of correct and incorrect answers, the number of presentation and inhibition errors, in the working memory and Go no Go tests (P= 0.005). However, the mean time component in the Go no Go test was not significant (P= 0.17).

Conclusion: These findings suggest that body psychotherapy can be an effective way to improve working memory ability and retention level among elementary students.

Keywords: Body psychotherapy, Elementary students, Inhibition, Working memory

Please cite this paper as:

Ghanaie F, Bigdeli I, Rasoolzadeh Tabatabai K. The effectiveness of body psychotherapy on improving working memory ability and inhibition level in elementary school students. Journal of Fundamentals of Mental Health 2020 Mar-Apr; 22(2): 114-21.

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Received: Jul. 23, 2019
Accepted: Dec. 22, 2019

Introduction

The importance of executive functions and working memory skills in academic achievement has been reiterated in a number of recent studies across a wide range of ages (1). Over the past 30 years, the concept of working memory has been extensively used, originating in cognitive psychology in many domains of cognitive science and neuroscience. Working memory refers to systems that are essential for keeping information in mind and for performing complex tasks such as reasoning, understanding, and learning (2), allowing students to remember and follow instructions and to develop solutions for a problem (3). A factor thought to play a key role in the development of mathematical skills is the capacity and efficiency of working memory, and executive actions. It is reported that impairments in working memory and cognitive flexibility limit students' ability to count, retrieve facts, and solve mathematical problems, because many tasks at the elementary schools (e.g., counting, solving single digit problems, and subtraction) often require students to store and manipulate information (4). The children with a greater working memory capacity have more cognitive resources to store and retain information while performing calculations and solving mathematical problems (5,6). Cognitive abilities are important sources of individual differences in reading ability. The idea that working memory is crucial for reading has been echoed in previous research as well (7).

Another major component of executive action is "inhibition", which has both cognitive and behavioral manifestations. Cognitive inhibition refers to the ability to suppress attention to irrelevant stimuli, reactions, and associations. Behavioral inhibition is also concerned with movement control, especially reactive and undesirable behaviors (8). The term inhibition came into use in neuroscience around nineteenth century (9). Complex response inhibition requires considerable working memory so that we can maintain an arbitrary rule in mind or preclude an answer by creating an alternative. It can therefore be argued that separating working memory from inhibition processes is difficult (10). The conducted studies suggest that children with learning difficulties in mathematics perform poorly on inhibition tasks compared to children with moderate performance in mathematics (11-14). Inhibition may be essential for suppressing inappropriate solutions such as aggregation during multiplication or suppressing irrelevant information such as information offered by unrelated issues to the problem (15). Inhibition is important for reading comprehension, as successful comprehension involves limiting and suppressing misleading representations caused by ambiguity in either lexicons or the context (7).

Cognitive processes of working memory and inhibition allow students to remember and follow teachers' instructions and focus on a particular task without distraction (3).

The recent evidences suggest that the experience of primary motor activity may pave the way for higher-order cognition, including executive actions. Regular motor activities in childhood are likely to activate and develop executive actions in the frontal area of brain (16). Physical activities have a great impact on cognition, learning, mood, and motivation (17). It has also been suggested that physical activity improves the academic performance of adolescent students (18). Motor activities offer an effective approach in students with learning difficulties (19). In this regard, Verret investigated the effect of physical activity on the cognitive functions of children with ADHD, suggesting that physical activity improves muscle capacity, motor skills, and information processing level (20).

Body Psychotherapy (BPT) is a science developed over the past seventy years based on the results of biology, anthropology, ethics, neuro-psychology, neurophysiology, developmental psychology, neonatology, prenatal studies, and other disciplines (21). An umbrella term encompassing other forms of psychotherapies, it explicitly recruits body techniques to foster dialogues between the client and the therapist about things they are experiencing and understanding. In physical psychotherapy, the body is considered as a mean of communication and exploration (22). It includes a set of exercises, basic techniques,

nonverbal communication, and interventions related to cognition of strength and physical ability to improve mental activity, and to stimulate emotional expression, moderate negative self-esteem, and discover alternative behaviors for conflict resolution (23).

According to previous research, the stimulation of the reticular formation in the brainstem increases awareness with all new sensory perceptions and movements being capable of generating such stimuli. This is an important mechanism that can be used in body psychotherapy. Different approaches to body psychotherapy address attention-related processes in various manners. Body psychotherapists help stabilize patients with symptoms of post-traumatic stress. It is argued that body psychotherapy experiences are likely to help the patient develop new neural pathways (24).

There are few studies in Iran and other countries on the application of body psychotherapy approach in improving the working memory and retention level of students (girls and boys) in elementary school. Therefore, the present study aimed to investigate the effectiveness of body psychotherapy in group therapy on improving working memory and level of inhibition in students.

Materials and Methods

The statistical population of this clinical trial consisted of all primary school students aged 7-12 years in Mashhad during 2018-19 academic year. The participants were selected using voluntary and purposeful sampling method. So, we first selected 4 elementary schools and the sample was chosen from among students who were willing to participate in the study. Based on the research design and according to the following formula, the minimum sample size for each group was estimated at 12 cases.

Sampling was conducted over one month from February to March 2019 under the supervision of the Research and Ethics Committee of Ferdowsi University of Mashhad. Inclusion criteria for participants were 7-12 years of age, studying at regular schools and no taking psychiatric medications. The exclusion criteria comprised reluctance of students or their parents to continue participation in the study and missing more than 3 consecutive sessions or more than 6 sessions during psychotherapy sessions.

The managers of the selected schools asked students' parents to attend a briefing session in which the research process was explained and they were encouraged to have their children participate in the research. A written consent form was also obtained from parents who consented to their children's participation in the research. They were also assured that their children's collaboration would free of charge for them. Finally, students who met the inclusion criteria were selected as the sample and randomized into two groups (experimental and control). Before applying the independent variable, both groups were evaluated by Go-No-Go working memory tests. Afterwards, students in the experiment group attended three 60-minute sessions (a total of 36 sessions) of body psychotherapy on a weekly basis for 3 months, but the control group received no intervention during this period. The intervention was performed by a body physiotherapist endorsed by Psychology Department of Ferdowsi University of Mashhad. After the end of sessions in the experimental group, both groups were evaluated. The results were presented and explained to parents who were interested in research outcomes. Finally, students in the control group who were interested in attending body psychotherapy sessions also received these sessions for 1 month, which comprised three 60-minute sessions per week (a total of 12 sessions). It is worth noting that this study caused no harm to participating students and the information obtained from evaluations during the research process was remained confidential. A summary of the body physiotherapy protocol in this study is presented in a general format, which is derived from the protocol proposed by Röhricht (22).

Table 1. A summary of the body physiotherapy protocol

Technique	Cognitive goals
Communication	-Experience of mental-physical relaxation - Increased focus and attention - Synchrony of cognitive structure and brain activity of children to participate in the exercises - Self-cognition - Sense of psychological harmony - Increased self-awareness - Enjoying exercises - The practice of creating a whole body image - Improvement and upgrading of inhibition - Strengthening self-discipline - Emotional discharge - Reduced aggression and psychological stress - Strengthening individual abilities
Exercises: -Briefing session -Dynamic flexibility and stretching exercises for upper and lower body that call for concentration -Guided movements -Reversal -Empowerment -Horizontal eye movement -Basic inhaling and exhaling techniques -Special exercises to build up strength and endurance Mindfulness exercises	
Exercises to revert to the initial state (cool down)	

Research instrument

A) N-BACK Test: This test is a cognitive performance assessment task related to executive actions, which was first introduced by Kirchner in 1958. Since this task involves the storage and manipulation of cognitive information, it is used to evaluate working memory (25). The test consists of two visual and auditory components. In the former, visual stimulus appear sequentially with 1800 milliseconds intervals on a display screen and the participants need to compare each stimulus with the previous one (26). If two consecutive stimuli are identical, number 1 and if they are different, number 2 is pressed. The error recognition percentage with Cronbach alpha equal to 0.51 and non-recognition percentage with reliability of 0.76, were obtained from this test (25).

B) Go/No-Go Test: The original version of this test, which was developed by Huffman in 1984, is widely used to evaluate behavioral inhibition (27). The test consists of two sets of congruent and incongruent stimuli where the subject need to respond to a set of stimuli (congruent ones) and avoid responding to another set of stimuli (incongruent ones). Failure to present adequate inhibition or execution error in this test occurs with motor response when delivering non-target stimuli. In the process of presenting stimuli, the "go" stimuli outnumber "not to go" stimuli, so the subject will be more ready to respond to these stimuli. All the answers and reaction time of the subjects are recorded and taken into account for scoring in this test. Qadiri et al. reported the validity of this test to be 0.87 (8).

C) Body Psychotherapy Session Packages: The protocol is chiefly designed to prepare the child for a free experience, but there are pre-determined practices and exercises in the treatment plan. The goal is to shift the child's self-awareness to potential and flexible abilities (22). The therapist allows a child to use movements and exercises as a model, giving them the freedom to perform any action or activity they desire unless it poses a threat to their health. Body psychotherapy involves a general framework with 9 steps in each session. Any changes in breathing volume, correct breathing, muscle tension and harmony of breathing rhythm with movements, and turning of eyes to the left and right sides are compared with previous sessions.

Data were analyzed using descriptive statistics, inferential statistics of independent t-test, and SPSS-23 software.

Results

It is worth noting that two students in the control group (one girl and one boy) were excluded due to non-cooperation, thereby the final sample was 42 students (12 boys and 10 girls in the experimental group and 10 boys and 10 girls in the control group). The mean age of students in the experimental group was 9.05 ± 1.59 years and the mean age of students in the control group was 9.20 ± 1.96 years.

As for school grade, 18.2% (n=4) students in the experimental group and 35% (n= 7) in the control group were in the first grade; 22.7% (n= 5) in and in the experimental group and 5% (n= 1) in the control group were in the second grade; 27.3% (n= 6) in the experimental group and 15% (n= 3) in the control group were in the third grade; 9.1% (n= 2) in the experimental group and 10% (n= 2) in the control group were in the fourth grade; 13.6% (n= 3) in the experimental group and 20% (n= 4) in the control group were in fifth grade, and 9.1% (n= 2) in the experimental group and 15% (n= 3) in the control group were in the sixth grade. The results of the Chi square homogeneity test (x^2) indicates no difference between the two groups in terms of grade level (x^2=4.7, *P*>0.05).

Given that the dependent variable was measured by two subscales of the N-BACK working memory test in the pretest and the posttest, body psychotherapy has a positive effect on improving working memory capacity in students, the multivariate analysis of covariance should be used. However, given that model assumptions including homogeneity of variance-covariance matrix and homogeneity of regression coefficients do not hold, the independent t-test was used to check significance of difference between pretest and posttest scores. The results are listed in the following table.

Table 2. Evaluation of homogeneity of groups variance in components of N-BACK test

Dependent variable of Levene's test	F statistics	P
Number of correct answers	0.015	0.905
Number of incorrect answers	0.014	0.905

According to Table 2, the significance level of Levene's test in components of the number of correct or incorrect answers is greater than 0.05. Thus, the assumption of variance homogeneity is confirmed.

Table 3. Comparing the components of N-BACK test in the experimental and control groups

Variable		Mean difference	Standard error of difference	T	df	P
Difference of the number of correct answers in the pre-test and post-test	Experimental	-12.09	4.36	-2.7	40	0.008
	Control	-12.09	4.36			
Difference of the number of incorrect answers in the pre-test and post-test	Experimental	15.30	4.63	3.30	40	0.002
	Control	15.30	4.64			

According to Table 3, the two components of N-BACK test are significantly different between the two groups. Therefore, body psychotherapy intervention is able to increase the number of correct answers (*P*=0.008) and decrease the number of incorrect answers (*P*=0.002) in this test, and the intervention had a positive effect on improving working memory of students in the experiment group.

Given that the dependent variable was measured by 3 subscales of the Go-No Go test in the pretest and the posttest, body psychotherapy has a positive effect on improving students' inhibition level, multivariate analysis of covariance should be used. However, since model assumptions including homogeneity of variance-covariance matrix and homogeneity of regression coefficients do not hold, the independent t-test was used to evaluate the significance of difference between pre-test and post-test scores. The results are reported in the following table.

Table 4. Evaluating the homogeneity of group variances in components of Go No-Go test

Dependent variable of Levene's test	F	P
Number of presentation error	0.623	0.435
Inhibition	0.742	0.394
Mean time	2.269	0.140

According to Table 4, the significance level of Levene's test in components of the number of presentation errors, inhibition and mean time is greater than 0.05, thus confirming the assumption of variance homogeneity.

Table 5. Comparing the components of Go No Go test in the experimental and control groups

Variable		Mean difference	Standard error of difference	T	df	P
Difference of the number of errors in the pretest and posttest	Experimental Control	4.02 4.02	1.38 1.39	2.92	40	0.006
Difference of inhibition in the pretest and posttest	Experimental Control	-5.54 -5.54	1.24 1.25	-4.46	40	0.001
Difference of mean time in the pretest and posttest	Experimental Control	37.25 37.25	27.13 27.64	1.37	40	0.177

As shown in Table 5, there is a significant difference between two of three components of Go No Go test between the two groups. Therefore, body psychotherapy intervention is able to decrease the number of presentation errors (*P*= 0.006) and increase inhibition (*P*= 0.001) in this test. In fact, this intervention has had a positive effect on improving the level of inhibition in the experimental group.

Discussion

Regarding the effect of movement therapy on the body and the psyche, it is considered a holistic rather than a one-dimensional therapy. The movement treatment has positive effect on physiological and psychological aspects. As a psychological intervention, movement can affect a person physically, emotionally and socially (28). Kang et al. examined the effect of exercise therapy on the cognitive function of children with ADHD aged 8 to 10 years. Exercise therapy was performed as 12 ninety-minute sessions twice a week. At the end of the intervention, they reported that exercise therapy had a positive effect on working memory (29), which aligns with the results of this study. On the contrary, Smith et al. in a study on kindergarten children found that 30 minutes of physical activity per session over 8 weeks did not cause significant changes in working memory and verbal memory (30), which are inconsistent with the outcomes of the present study. Tsai et al. in their study on 80 children observed that physical activity, physical fitness, and aerobic exercise had a positive effect on inhibition skills. In this study, the children's inhibition skills were measured by the Flanker task (31). Hence, the results of Tsai's research align well with those of this study. In contrast, (32) explored the effect of moderate to severe physical activity on inhibition in normal children, concluding that physical activity did not have any significant effect on response inhibition. Physical activity has been shown to enhance and protect brain function (33). Motor activities create conditions that contribute to motor and cognitive learning by activating the nervous system and its connections throughout the body. In fact, it can be argued that motor activity is one of the most effective ways to amplify brain capacity (34).

One of the limitations of this study is that students were not randomly selected from all schools in Mashhad. Rather, students were selected using available sampling method from one of the Mashhad districts. Since the

participating students were 7 to 12 years old, caution should be practiced in generalizing the results to other ages. The lack of follow-up studies due to time constraints can also be noted as another constraint of this study. Therefore, to increase the exhaustiveness of the results, it is recommended that follow-up studies be conducted to determine the sustainability of outcomes.

Conclusion

The results of this study suggest that body psychotherapy intervention can improve working memory and the level of inhibition in elementary students.

In general, this research design offers an appropriate model for improving and reinforcing level of inhibition and working memory in elementary students. Various studies have shown that psychological problems arise from dysfunction of the nervous system. Therefore, according to the results of this study, if interventional methods such as body psychotherapy are used to modify the nervous system, these neuropsychological problems can be more effectively managed. According to the results, improved working memory ability and level of inhibition were observed in students at the end of body psychotherapy courses, which is evidence of desirable changes in the nervous system.

Acknowledgment

This research is based on the Master Dissertation written by Fatemeh Ghanaie, a graduate of Ferdowsi University of Mashhad. After being approved by the Research Committee of the Faculty of Education and Psychology, this study was conducted without any financial support and conflict of interests. The researchers would like to express their gratitude to the Education Department authorities of Mashhad, school principals, students and families who participated in the study.

References

1. Bull R, Andrews Espy K, Wiebe SA. Short-term memory, working memory, and executive functioning in preschoolers: Longitudinal predictors of mathematical achievement at age 7 years. Dev Neuropsychol 2008; 33(3): 205-28.

2. Baddeley A. Working memory. Curr Biol 2010; 20(4): R136-R140.

3. McClelland MM, Cameron CE, McDonald Connor C, Farris CL, Jewkes AM, Morrison FJ. Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. Dev Psychol 2007; 43(4): 947-59.

4. Morgan PL, Li H, Farkas G, Cook F, Hung Pun W, Hillemeieret M. Executive functioning deficits increase kindergarten children's risk for reading and mathematics difficulties in first grade. Contemp Educ Psychol 2017; 50: 23-2.

5. Swanson L , Kim K. Working memory, short-term memory, and naming speed as predictors of children's mathematical performance. Intelligence 2007; 35(2): 151-68.

6. Cantin RH, Gnaedinger CK, Gallaway KC, Hesson-McInnis MS, Hund AM. Executive functioning predicts reading, mathematics, and theory of mind during the elementary years. J Exp Child Psychol 2016; 146: 66-78.

7. Christopher ME, Miyake A, Keenan JM, Pennington B, Defries JC,Wadsworth SJ, et al. Predicting word reading and comprehension with executive function and speed measures across development: a latent variable analysis. J Exp Psychol Gen 2012; 141(3): 470-88.

8. Hosseinzadeh Maleki Z, Mashhadi A, Ghanaei Ghamanabad A, Soltanifar A, Moharreri F, Hosseini Z, et al. [The combination of parental education and working memory training on inhibition executive function of children with attention deficit/hyperactivity disorder]. Journal of rehabilitation medicine 2013; 3(2): 95-114. (Persian)

9. Aron AR. The neural basis of inhibition in cognitive control. Neuroscientist 2007; 13(3): 214-28.

10. Best JR. Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. Dev Rev 2010; 30(4): 331-51.

11. Szucs D, Devine A, Soltesz F, Nobes A, Gabriel F. Developmental dyscalculia is related to visuo-spatial memory and inhibition impairment. Cortex 2013; 49(10): 2674-88.

12. Wang LC, Tasi HJ, Yang HM. Cognitive inhibition in students with and without dyslexia and dyscalculia. Res Dev Disabil 2012; 33(5): 1453-61.

13. Winegar KL. Inhibition performance in children with math disabilities. Ph.D. Dissertation. UC Riverside: University of California, 2013: 1-16.
14. Gilmore C, Keeble S, Richardson S, Cragg L. The role of cognitive inhibition in different components of arithmetic. ZDM 2015; 47(5): 771-82
15. Friso-Van Den Bos I, Van der ven SHG, Krosebergen EH, Vanluit GEH. Working memory and mathematics in primary school children: A meta-analysis. Educ Res Rev 2013; 10: 29-44.
16. Best JR, Miller PH. A developmental perspective on executive function. Child Dev 2010; 81(6): 1641-60.
17. Alexander N, Lebaron M. Dancing to the rhythm of the role-play, applying dance intelligence to conflict resolution. Hamline journal of public law and policy 2012; 33(2): 327-62.
18. Fox CK, Barr-Anderson D, Neumark-Sztainer D, Wall M. Physical activity and sports team participation: Associations with academic outcomes in middle school and high school students. J Sch Health 2010; 80(1): 31-7.
19. Mullane S, Dunphy K. Dance movement therapy and student learning and well-being in special education. London: Oxford University Press; 2010: 493-16.
20. Verret C, Guay M-C, Berthiaume C, Gardiner P, Béliveau L. A physical activity program improves behavior and cognitive functions in children with ADHD: an exploratory study. J Attend Disord 2012; 16(1): 71-80.
21. Young C. The science of body psychotherapy: The science of body psychotherapy today part 1. A background history. The USA body psychotherapy journal 2009; 8(2): 1-71.
22. Röhricht F, Papadopoulos N, Priebe S. An exploratory randomized controlled trial of body psychotherapy for patients with chronic depression. J Affect Disord 2013; 151(1): 85-91.
23. Winter D, Malighetti C, Cipolletta S, Ahmed S, Benson B, Röhricht F. Construing and body dissatisfaction in chronic depression: A study of body psychotherapy. Psychiatry Res 2018; 270: 845-51.
24. Marlock G, Weiss H , Gottwald C. Neurobiological perspectives on body psychotherapy. The Handbook of body psychotherapy and somatic psychology. Berkeley, California: North Atlantic Books; 2015: 126-48.
25. Bayat Mokhtari L, Agha Yousefi A, Zare H, Zare V. [The considering of the impact of transcranial Direct Current Stimulation (tDCS) and phonological awareness training on improvement of the visual aspect function of the working memory in children with dyslexia]. Neuropsychology 2017; 2(8): 50-67.(Persian)
26. Nejati V, Bahrami H, Abravan M, Robenzade Sh, Motiei H. [Executive function and working memory in attention deficit / hyperactivity disorder and healthy children]. Journal of Gorgan University of Medical Sciences 2013; 15(3): 69-76. (Persian)
27. Wodka E, Mark Mahone E, Blankner G, Gidley Larson J, Fotedar S, Denckla M, et al. Evidence that response inhibition is a primary deficit in ADHD. J Clin Exp Neuropsychol 2007; 29(4): 345-56.
28. Van der Merwe S. The effect of a dance and movement intervention program on the perceived emotional well-being and self-esteem of a clinical sample of adolescents. MA. Dissertation. University of Pretoria, 2010.
29. Kang K, Choi J, Kang S, Han D. Sports therapy for attention, cognitions and sociality. Int J Sports Med 2011; 32(12): 953-59.
30. Smith AL, Tsai YJ, Hoza B, Linnea K, Mcquade JD, Tomb M, et al. Pilot physical activity intervention reduces severity of ADHD symptoms in young children. J Attend Disord 2013; 17(1): 70-82.
31. Tsai YJ, Hung CL, Linnea K, Mcquade JD, Tomb M, Shoulberg EK, et al. The relationship between physical fitness and inhibitory ability in children with attention deficit hyperactivity disorder: An event-related potential study. Psychol Sport Exerc 2017; 31: 149-57.
32. Pindus DM, Drollette ES, Scudder MR, Khan NA, Raine LB, Sherar LB, et al. Moderate-to-vigorous physical activity, indices of cognitive control, and academic achievement in preadolescents. J Pediatr 2016; 173: 136-42.
33. Cotman CW, Engesser-Cesar C . Exercise enhances and protects brain function. Exerc Sport Sci Rev 2002; 30(2): 75-9.
34. Ghanayi Chemanabad A, Kareshki H. Effect of rhythmic movements learning on intelligence and social development of preschool children. The horizon of medical sciences 2013; 18(4): 203-7.