Int J Clin Exp Med 2020;13(10):7544-7551
www.ijcem.com /ISSN:1940-5901/IJCEM0116102

Original Article

Intervention with baduanjin can improve motor function and cognitive function in patients with apoplectic hemiplegia

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Received June 11, 2020; Accepted August 15, 2020; Epub October 15, 2020; Published October 30, 2020

Abstract: Objective: Intervention with baduanjin can improve motor function and cognitive function in patients with apoplectic hemiplegia. Methods: A total of 116 patients with apoplectic hemiplegia admitted to our hospital were selected as the research participant in this experiment. Sixty-eight patients were treated with Baduanjin intervention (research group, RG). Another 48 patients were treated with routine rehabilitation training (control group, CG). The motor function, cognitive function, living ability, degree of functional nervous defects, language function recovery, efficacy and quality of life were evaluated in the two groups after intervention for one year. Results: The motor function, cognitive function, living ability and language function recovery in the RG were higher than those in the CG after intervention (P<0.05), and the functional nervous defect was lower than in the CG (P<0.05). The total effective rate in the RG was higher than that in the CG (P<0.05), and the quality of life was better than in the CG (P<0.05). Conclusion: Baduanjin is simple and easy to learn and has high safety. It can improve the motor function and cognitive function in patients with apoplectic hemiplegia and it is of great significance because it improves the recovery of patients with apoplectic hemiplegia.

Keywords: Apoplectic hemiplegia, baduanjin, motor function, cognitive function

Introduction

Cerebral apoplexy, commonly known as stroke, is the leading cause of death among Chinese people [1]. Cerebrovascular damage, focally or throughout the brain can lead to long lasting clinical symptoms or even death [2]; this type of tissue damage is characterized by a high incidence rate, high disability rate, high recurrence rate and high mortality rate [3]. Moreover, with social progress, people's living habits have changed, and the incidence age of a stroke has become younger, making it a major disease that threatens human life and health [4]. At present, with the continuous progress of clinical medicine, the methods for treating stroke are gradually maturing, and the fatality rate of stroke patients is continuously decreasing [5]. However, a stroke will cause different degrees of damage to the central nervous system in the cerebrum during the onset of the disease, which will lead to stroke symptoms and hemiplegia caused by pathological changes on the affected side of the brain, and as a result the disability rate is still high [6]. Hemiplegia is the most common sequelae of stroke, which mainly refers to a movement disorder of the upper and lower limbs and facial muscles on one side, which seriously affects the daily life of patients [7]. Rehabilitation training is a routine treatment for patients with apoplectic hemiplegia, but its therapeutic effect is not very ideal [8]. In view of this, in order to effectively treat patients with apoplectic hemiplegia and improve their condition, finding effective treatment measures is still the focus of clinical research.

The exercise therapy is one of the best methods to treat limb dysfunction [9]. Looking at previous data, it has been shown that baduanjin is very suitable for patients with relatively reduced motor function [10]. Baduanjin is a set of guiding techniques consisting of eight movements, which are soft and slow, round and coherent, elastic with tight combinations, and dynamic and static guidance. Many studies have also revealed that baduanjin has the effects of regulating blood lipids, lowering blood glucose, as well as preventing and treating hypertension [11]. Blood glucose and hypertension are risk factors for stroke patients. In addition, some studies have revealed that baduanjin can promote cognitive function [12]. Therefore, we have speculated that the application of baduanjin intervention can help patients with apoplectic hemiplegia to recover better. Therefore, this study was designed to provide effective prevention and treatment reference suggestions for future clinical treatment of patients with apoplectic hemiplegia by exploring the influence of baduanjin intervention on motor function and cognitive function of patients with apoplectic hemiplegia.

Materials and methods

Collection of patient's data

From May 2016 to May 2018, 116 patients with apoplectic hemiplegia admitted to our hospital were selected as the research participants for prospective analysis. A total of 68 patients were treated with Baduanjin intervention (RG). Another 48 patients were treated with routine rehabilitation training (CG). The experiment was approved by the Ethics Committee of our hospital and all the subjects have signed informed consent forms.

Patient's selection criteria

Inclusion criteria: The selected patients were diagnosed with apoplectic hemiplegia by imaging after laboratory examination in our hospital. All patients had complete case data and agreed to cooperate with the medical staff and participate in the arrangement of our hospital. The patient's immediate family members signed the informed consent form.

Exclusion criteria were as follows: patients with cardiac and pulmonary dysfunction; comorbid with multiple chronic diseases; patients with mental diseases and language communication disorders; patients with bone and joint diseases that were not suitable for exercise; patients with hypertension, diabetes and other chronic diseases.

Methods

In both groups, patients were treated with blood pressure, blood lipid and blood glucose control. In the CG, patients received physical therapy mainly based on Bobath technique, including moving the shoulder girdle, practicing side turning, sitting on one's side, wrist and ankle back stretching exercises, limb control exercises, balance training to patients, walking training and daily activities training. The above training was performed 1 time/day, 15 min/time, 6 days/week, with a total of 6 weeks of training. In the RG, patients were trained in 8 movements of baduanjin. The details were shown below: Two hands supporting the sky - (to regulate all internal organs); Drawing bows left and right (like archery); Single hand pushing up - (to help the spleen and stomach); Turning head to look left and right - (to relax the neck muscles); Pointing tailbone left and right - (to ease heart burnt); Both hands reaching the ground - (to strengthen kidney and waist); Lifting fists - (to generate energy); Bouncing on the toes - (to rid sickness). It could be adjusted according to the patient's own condition. The total exercise time was 50 minutes.

Outcome measures

The simplified Fugl-Meyer Motor Function Assessment Scale (FMA) was used to assess the motor function of patients in the two groups after intervention [13]. The Mini-Mental State Examination (MMSE) was used to assess the cognitive function of patients in the two groups [14]. The Activity of Daily Living (ADL) Barthel Index Assessment Scale was used to assess the living ability of patients in the two groups after intervention [15]. The degree of functional nervous defect was assessed in the two groups after intervention by clinical neurological impairment score (NDS) [16]. The language function recovery was compared in the two groups by modified Boston Chinese aphasia test [17]. The efficacy was assessed in the two groups according to neurological impairment and living ability [18]. The quality of life was

Table 1. Baseline data

	RG (n=68)	CG (n=48)	t or X^2	P
Age (years old)	46.3±6.6	47.2±7.5	0.496	0.684
Gender			0.149	0.700
Male	49 (72.06)	33 (68.75)		
Female	19 (27.94)	15 (31.25)		
BMI (KG/cm^2)	23.52±3.05	24.46±4.72	0.195	1.303
Living environment			0.095	0.758
Town	43 (63.24)	29 (60.42)		
Rural	25 (36.76)	19 (39.58)		
Education level			0.508	0.476
< high school	38 (55.88)	30 (62.50)		
≥ high school	30 (44.12)	18 (37.50)		
Smoking history			0.064	0.801
Yes	51 (75.00)	35 (72.92)		
No	17 (25.00)	13 (27.08)		
Alcoholism history			0.552	0.457
Yes	47 (69.12)	30 (62.50)		
No	21 (30.88)	18 (37.50)		
Family history			0.316	0.574
Yes	18 (26.47)	15 (31.25)		
No	50 (73.53)	33 (68.75)		
Nation			1.015	0.314
Han	61 (89.71)	40 (83.33)		
Minority nationality	7 (10.29)	8 (16.67)		

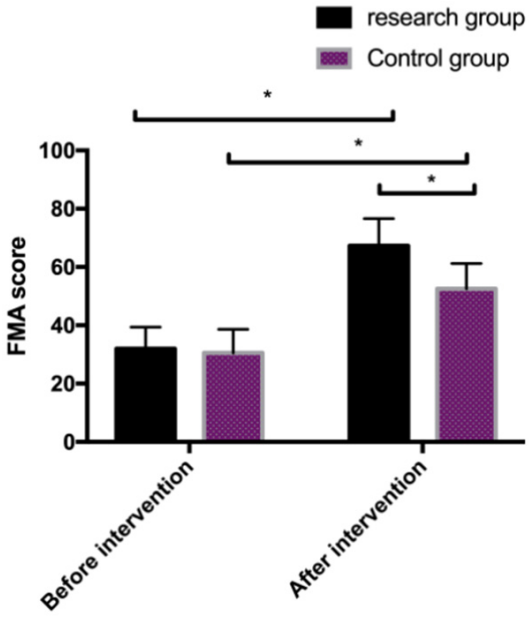

Figure 1. Motor function of patients in the two groups before and after intervention. Note: * indicates P<0.05.

observed in the two groups after intervention for one year.

Statistical methods

SPSS 22.0 was used to perform statistical analysis on the data results. Graphpad7 was used to illustrate the data results. The counting data were expressed by (rate). Chi-square test was used for comparison between groups. The measurement data were expressed as (mean number ± standard deviation), and t test was used for comparison between groups. The difference was statistically significant with P<0.05.

Results

Comparison of baseline data

There was no difference in age, gender, BMI, living environment, education level, smoking history, history of alcoholism, family history and nationality between the two groups (P>0.05) (**Table 1**).

Motor function of patients in the two groups before and after intervention

The motor function scores of patients were evaluated before and after intervention. The results showed that there was no significant difference in the exercise scores between the RG and CG before intervention with baduanjin (P>0.05). After intervention, the scores were significantly increased in the two groups, and the RG was significantly higher than the CG (P<0.05) (**Figure 1**).

Cognitive function of patients in the two groups before and after intervention

The cognitive function scores were evaluated in the two groups before and after the intervention. The results showed that there was no significant difference in the cognitive function scores of patients in the two groups before intervention with Baduanjin (P>0.05). After intervention, the scores were significantly increased in the two groups, and the score in the RG was significantly higher than the CG (P<0.05) (**Figure 2**).

Life ability of patients in both groups before and after intervention

The life ability scores were evaluated in the two groups before and after the intervention. The

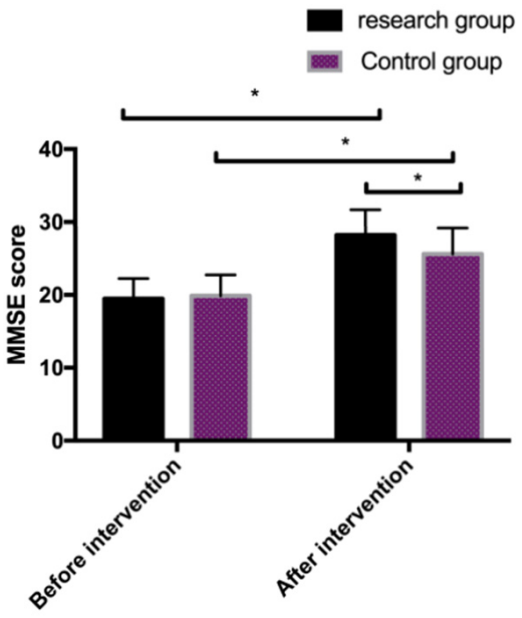

Figure 2. Cognitive function of patients in the two groups before and after intervention. Note: * indicates P<0.05.

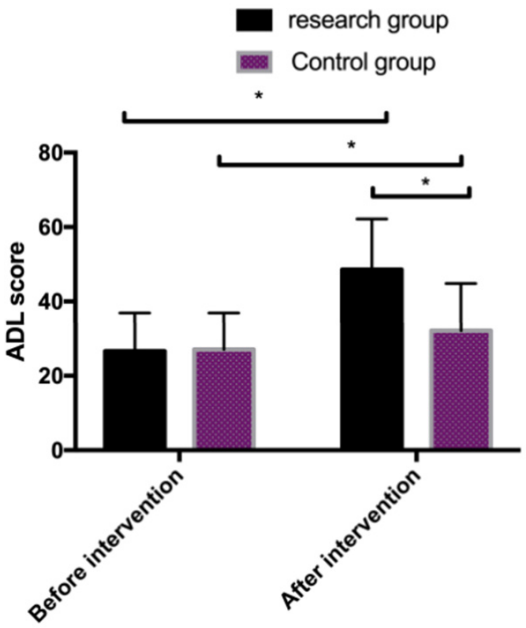

Figure 3. Life ability of patients in both groups before and after intervention. Note: * indicates P<0.05.

results showed that there was no difference in ADL scores between the two groups before intervention with Baduanjin (P>0.05). After intervention, the ADL scores were increased in both groups, and the score in the RG was higher than the CG (P<0.05) (**Figure 3**).

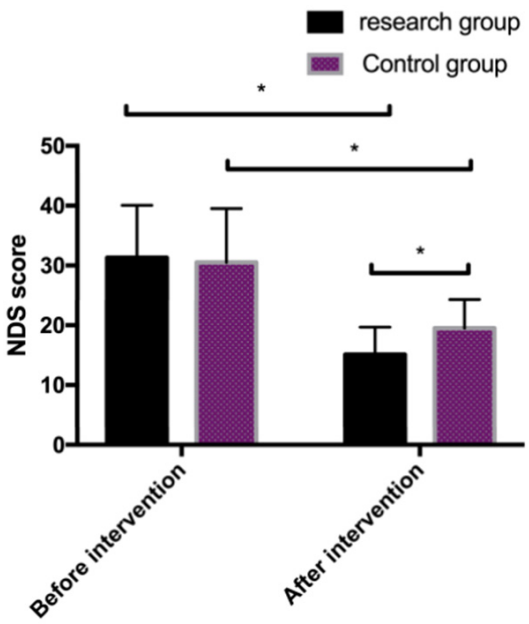

Figure 4. Degree of nervous functional defects of patients in the two groups. Note: * indicates P<0.05.

Degree of functional nervous defect of patients in the two groups

The neurological deficits were evaluated in the two groups before and after the intervention. The results showed that there was no difference in neurological function scores between the two groups before intervention (P>0.05). After intervention, the neurological function scores were significantly reduced in the two groups, and the score in the RG was significantly lower than the CG (P<0.05) (**Figure 4**).

Language function recovery of patients in the two groups

Aphasia test was used to detect the language function recovery of patients in the two groups before and after the intervention. The results showed that the language function of patients had no difference in the two groups before the intervention (P>0.05). The language function in the two groups was improved after the intervention, and the score in the RG was significantly better than the CG (P<0.05) (**Figure 5**).

Evaluation of efficacy in the two groups after intervention

The treatment efficacy was detected in the two groups after intervention. The results showed

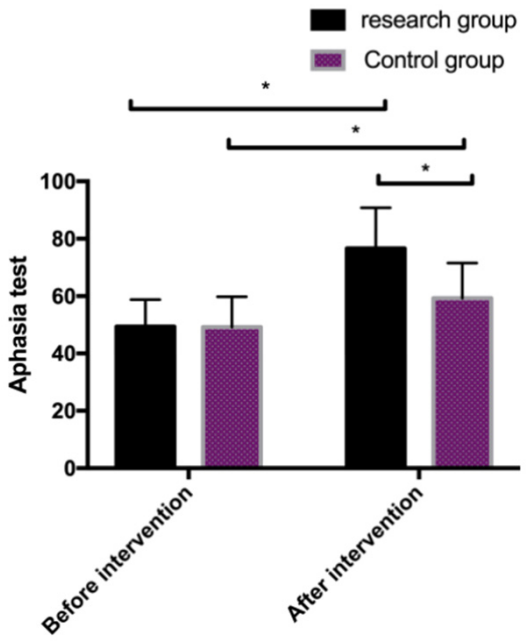

Figure 5. Language function recovery of patients in the two groups. Note: * indicates P<0.05.

that the total effective rate of the RG was 97.06%, and that of the CG was 85.42%. The RG was significantly higher than the CG, with statistical difference (P<0.05) (**Table 2**).

The quality of life in the two groups after intervention for one year

The quality of life was observed in the two groups after intervention. The results showed that the scores of body, role, emotion, cognition, society and other dimensions of the quality of life in the RG after intervention were significantly better than those of the CG (P<0.05) (**Table 3**).

Discussion

Stroke, also known as cerebral apoplexy, has a relatively high incidence rate among the elderly [19]. At this stage, with the change of people's living habits, there has been a trend of stroke patients getting younger [20]. Stroke is mainly caused by acute cerebrovascular diseases, with a high disability rate and death rate [21]. Hemiplegia is one of the more common sequelae of stroke. Motor nerve damage after stroke easily causes patients to lose their motor function to different degrees, resulting in a series of functional disorders (consciousness, movement, language and other functions), which will seriously affect the normal life of patients [22]. However, some studies have revealed that nerve injury has certain plasticity, and early intervention can restore some nerve injury [23]. Rehabilitation therapy is a commonly used therapy in modern rehabilitation disciplines, but there are still many imperfections and the therapeutic effect is controversial [24]. However, baduanjin is a traditional exercise method that combines breathing, with expiration and inspiration and psychological regulation. Its curative effect has been recognized by many clinical studies [25]. Therefore, this experiment was designed to study the effect of baduanjin intervention on motor function and cognitive function of patients with apoplectic hemiplegia, and the results were as follows.

The results of this experiment showed that the motor function score of patients in the RG undergoing baduanjin intervention was significantly higher than that of patients in the CG undergoing conventional rehabilitation training, suggesting that baduanjin intervention played a very important role in limb function recovery of patients with apoplectic hemiplegia. This was also consistent with the effect of baduanjin intervention mentioned in previous studies. For example, the author Chen T [26] has revealed that baduanjin intervention can improve executive control function. Additionally, author Zou L [27] has proposed that baduanjin exercise therapy has a better effect on rehabilitation of stroke patients. All of these support the results of this experiment. Baduanjin is a traditional exercise method in China, which was formed in the Northern Song Dynasty and it has a long history [28]. Dynamic and static, and hardness and softness are combined to regulate the body and mind and qi blood of patients [29]. Every movement has its main exercise purpose: 1, Stretching the limbs and trunk increases diaphragm movement. 2, Cardiopulmonary rhythmic exercise can increase the exercise of chest, the ribs and shoulder muscles, and improve patients' stability. 3, The upper limbs are alternately raised and lowered to press the spleen and stomach to promote gastrointestinal peristalsis. 4, Moving the cervical spine can enhance the stability of the human body. 5, Extending exhalation and bending down to turn can eliminate sympathetic nerve excitement and exercise the stability of multiple azimuth human body. 6, The waist movement forward and backward can dredge the

Table 2. Evaluation of efficacy in the two groups after intervention

	RG (n=68)	CG (n=48)	X^2	P
Basic recovery	19 (27.94)	6 (12.50)		
Obvious improvement	31 (45.59)	19 (39.58)		
Improvement	16 (23.53)	16 (33.33)		
Unchanged	2 (2.94)	7 (14.58)		
Deterioration	0 (0.00)	0 (0.00)		
Total effective rate (%)	66 (97.06)	41 (85.42)	5.329	0.021

Table 3. Comparison of quality of life between the two groups

	RG (n=68)	CG (n=48)	t value	*p* value
Body	94.31±4.34	86.43±4.25	9.714	<0.001
Role	83.67±3.48	69.22±3.17	22.840	<0.001
Emotion	87.53±3.15	71.64±3.45	25.720	<0.001
Cognition	92.69±3.79	83.67±3.63	12.850	<0.001
Society	62.21±4.11	52.73±3.64	12.820	<0.001

belt vessel, governor vessel and conception vessel, exercise the strength of the waist and back muscles, and mobilize the strength of the whole body. 7, Facial features cooperate with limb activities to enhance vital capacity. 8, The rhythmic elastic movement of the heel improves the stability of the lumbar spine [30]. The whole movement enlarges the torque of the arm through the rotation of the arm. The pressure on the arm is increased to more effectively improve the motor function of the affected limb in patients with apoplectic hemiplegia. Moreover, we have speculated that the reason why baduanjin intervention is more beneficial to the recovery of patients' limbs is that baduanjin's movements are simple and easy to understand. Compared with professional rehabilitation training, patients have an easier time to master them and they can exercise by themselves, so the recovery speed is faster and the effect is better. The cognitive function scores were evaluated in the two groups before and after the intervention. The results showed that there was no significant difference in cognitive function scores between the two groups before the intervention, while the score in the RG was significantly higher than the CG after intervention. This further revealed the feasibility of baduanjin intervention for patients with apoplectic hemiplegia. Studies have shown that regular exercise can stimulate the metabolism of neurons in the brain and improve the plasticity of synapses [31]. The whole set of movements of baduanjin are simple and concise, and it focuses on the management and control of mental activities. Therefore, we have speculated that the patient's learning, memory, attention and executive function are improved by repeated movement learning and movement conversion, thus affecting the nervous system function, improving synaptic plasticity, and further improving the cognitive function of the patient. Author Zheng G [32] has proposed that baduanjin intervention has a better effect on improving cognitive function of the elderly with weak cognition, which supports our experimental results. We further investigated the living ability, degree of nervous functional defects and language function recovery in the two groups. The results showed that the living ability of the RG was significantly improved after the intervention, which was higher than that of the CG. The neurological impairment was significantly reduced and lower than that in the CG. The language function recovery in the RG was better than that of the CG. Cognitive function is the brain's overall perception of external things, including execution, feeling and language [33]. Therefore, the cognitive function is improved, so the living ability, neurological function and language function of the patients are also significantly improved. This reveals the application value of baduanjin intervention for patients with apoplectic hemiplegia. After intervention, the evaluation of the curative effect in the two groups showed that the recovery effective rate of the patients in the RG with baduanjin intervention was significantly higher than that in the CG with routine rehabilitation training. We measured the quality of life in the two groups after intervention treatment for one year. The quality of life of the patients in the RG was significantly better than that in the CG. Compared with rehabilitation therapy, baduanjin intervention therapy has achieved more significant results and it is more favorable for the prognosis of patients.

Of course, there are still some deficiencies in this study. For example, there are many rehabilitation methods in clinical practice, but there is still great controversy about the choice of the best treatment mode for apoplectic hemiplegia. In this article, only routine rehabilitation treatment is used as a control, so it is not excluded that the application of baduanjin

intervention may differ from the results of this experiment when compared with other modes. Secondly, the study time is relatively short and the long-term effects of baduanjin intervention have not been observed in this study. We will expand the sample size of the study, prolong the experimental period and conduct more detailed and comprehensive experimental analysis to obtain more perfect experimental results.

To sum up, baduanjin is simple and easy to learn and has high safety. It can improve the motor function and cognitive function in patients with apoplectic hemiplegia and it is of great significance to improve the recovery of patients with apoplectic hemiplegia.

Disclosure of conflict of interest

None.

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References

[1] Feigin VL, Norrving B and Mensah GA. Global Burden of Stroke. Circ Res 2017; 120: 439-448.

[2] Lutz BJ. Effects of physical fitness training on mortality, independence and disability after stroke unclear. Evid Based Nurs 2010; 13: 18.

[3] Levac DE, Huber ME and Sternad D. Learning and transfer of complex motor skills in virtual reality: a perspective review. J Neuroeng Rehabil 2019; 16: 121.

[4] Mehrholz J, Thomas S, Werner C, Kugler J, Pohl M and Elsner B. Electromechanical-assisted training for walking after stroke. Cochrane Database Syst Rev 2017; 5: CD006185.

[5] Thrift AG, Howard G, Cadilhac DA, Howard VJ, Rothwell PM, Thayabaranathan T, Feigin VL, Norrving B and Donnan GA. Global stroke statistics: an update of mortality data from countries using a broad code of "cerebrovascular diseases". Int J Stroke 2017; 12: 796-801.

[6] Ntaios G, Swaminathan B, Berkowitz SD, Gagliardi RJ, Lang W, Siegler JE, Lavados P, Mundl H, Bornstein N, Meseguer E, Amarenco P, Cucchiara B, Camps-Renom P, Makaritsis K, Korompoki E, Papavasileiou V, Marti-Fabregas J, Milionis H, Vemmos K, Connolly SJ and Hart RG; NAVIGATE ESUS Investigators. Efficacy and safety of rivaroxaban versus aspirin in embolic stroke of undetermined source and carotid atherosclerosis. Stroke 2019; 50: 2477-2485.

[7] Tsuchimoto S, Shindo K, Hotta F, Hanakawa T, Liu M and Ushiba J. Sensorimotor connectivity after motor exercise with neurofeedback in post-stroke patients with hemiplegia. Neuroscience 2019; 416: 109-125.

[8] Song GF, Wu CJ, Dong SX, Yu CH and Li X. Rehabilitation training combined acupuncture for limb hemiplegia caused by cerebral hemorrhage: a protocol for a systematic review of randomized controlled trial. Medicine (Baltimore) 2019; 98: e14726.

[9] Shen C, Liu F, Yao L, Li Z, Qiu L and Fang S. Effects of MOTOmed movement therapy on the mobility and activities of daily living of stroke patients with hemiplegia: a systematic review and meta-analysis. Clin Rehabil 2018; 32: 1569-1580.

[10] Zou L, Sasaki JE, Wei GX, Huang T, Yeung AS, Neto OB, Chen KW and Hui SS. Effects of mind(-)body exercises (Tai Chi/Yoga) on heart rate variability parameters and perceived stress: a systematic review with meta-analysis of randomized controlled trials. J Clin Med 2018; 7: 404.

[11] Zou L, SasaKi JE, Wang H, Xiao Z, Fang Q and Zhang M. A systematic review and meta-analysis baduanjin qigong for health benefits: randomized controlled trials. Evid Based Complement Alternat Med 2017; 2017: 4548706.

[12] Tao J, Chen X, Egorova N, Liu J, Xue X, Wang Q, Zheng G, Li M, Hong W, Sun S, Chen L and Kong J. Tai Chi Chuan and Baduanjin practice modulates functional connectivity of the cognitive control network in older adults. Sci Rep 2017; 7: 41581.

[13] Zhou M, Li F, Lu W, Wu J and Pei S. Efficiency of neuromuscular electrical stimulation and transcutaneous nerve stimulation on hemiplegic shoulder pain: a randomized controlled trial. Arch Phys Med Rehabil 2018; 99: 1730-1739.

[14] Ciesielska N, Sokolowski R, Mazur E, Podhorecka M, Polak-Szabela A and Kedziora-Kornatowska K. Is the Montreal Cognitive Assessment (MoCA) test better suited than the Mini-Mental State Examination (MMSE) in mild cognitive impairment (MCI) detection among people aged over 60? Meta-analysis. Psychiatr Pol 2016; 50: 1039-1052.

[15] Azad A, Mohammadinezhad T, Taghizadeh G and Lajevardi L. Clinical assessment of activities of daily living in acute stroke: validation of the Persian version of Katz Index. Med J Islam Repub Iran 2017; 31: 30.
[16] Pan XL. Efficacy of early rehabilitation therapy on movement ability of hemiplegic lower extremity in patients with acute cerebrovascular accident. Medicine (Baltimore) 2018; 97: e9544.
[17] Wang Y, Li H, Wei H, Xu X, Jin P, Wang Z, Zhang S and Yang L. Assessment of the quality and content of clinical practice guidelines for post-stroke rehabilitation of aphasia. Medicine (Baltimore) 2019; 98: e16629.
[18] Zhang CY, Han HD, Wang SY, Huang SR and Deng BQ. Pentraxin-3 in Thrombolytic therapy for acute ischemic stroke: no relation with curative effect and prognosis. Med Sci Monit 2018; 24: 4427-4432.
[19] Khoshnam SE, Winlow W, Farzaneh M, Farbood Y and Moghaddam HF. Pathogenic mechanisms following ischemic stroke. Neurol Sci 2017; 38: 1167-1186.
[20] Laichuthai N, Abdul-Ghani M, Kosiborod M, Parksook WW, Kerr SJ and DeFronzo RA. Newly discovered abnormal glucose tolerance in patients with acute myocardial infarction and cardiovascular outcomes: a meta-analysis. Diabetes Care 2020; 43: 1958-1966.
[21] Sommer CJ. Ischemic stroke: experimental models and reality. Acta Neuropathol 2017; 133: 245-261.
[22] Sarikaya H, Ferro J and Arnold M. Stroke prevention--medical and lifestyle measures. Eur Neurol 2015; 73: 150-157.
[23] Pourhosseingholi E, Farahmand B, Bagheri A, Kamali M and Saeb M. Efficacy of different techniques of AFO construction for hemiplegia patients: a systematic review. Med J Islam Repub Iran 2019; 33: 50.
[24] Zheng JQ, Lai HJ, Zheng CM, Yen YC, Lu KC, Hu CJ, Lee HH and Wang YH. Association of stroke subtypes with risk of hip fracture: a population-based study in Taiwan. Arch Osteoporos 2017; 12: 104.
[25] Zou L, Wang C, Chen X and Wang H. Baduanjin exercise for stroke rehabilitation: a systematic review with meta-analysis of randomized controlled trials. Int J Environ Res Public Health 2018; 15: 600.
[26] Chen T, Yue GH, Tian Y and Jiang C. Baduanjin mind-body intervention improves the executive control function. Front Psychol 2016; 7: 2015.
[27] Zou L, Yeung A, Zeng N, Wang C, Sun L, Thomas GA and Wang H. Effects of mind-body exercises for mood and functional capabilities in patients with stroke: an analytical review of randomized controlled trials. Int J Environ Res Public Health 2018; 15.
[28] Lu Y, Qu HQ, Chen FY, Li XT, Cai L, Chen S and Sun YY. Effect of Baduanjin Qigong exercise on cancer-related fatigue in patients with colorectal cancer undergoing chemotherapy: a randomized controlled trial. Oncol Res Treat 2019; 42: 431-439.
[29] Zhao F, Sun S, Xiong J and Zheng G. The effect of Baduanjin exercise on health-related physical fitness of college students: study protocol for a randomized controlled trial. Trials 2019; 20: 569.
[30] Liu J, Tao J, Liu W, Huang J, Xue X, Li M, Yang M, Zhu J, Lang C, Park J, Tu Y, Wilson G, Chen L and Kong J. Different modulation effects of Tai Chi Chuan and Baduanjin on resting-state functional connectivity of the default mode network in older adults. Soc Cogn Affect Neurosci 2019; 14: 217-224.
[31] Zheng G, Chen B, Fang Q, Lin Q, Tao J and Chen L. Baduanjin exercise intervention for community adults at risk of ischamic stroke: a randomized controlled trial. Sci Rep 2019; 9: 1240.
[32] Zheng G, Huang M, Li S, Li M, Xia R, Zhou W, Tao J and Chen L. Effect of Baduanjin exercise on cognitive function in older adults with mild cognitive impairment: study protocol for a randomised controlled trial. BMJ Open 2016; 6: e010602.
[33] Loughrey DG, Kelly ME, Kelley GA, Brennan S and Lawlor BA. Association of age-related hearing loss with cognitive function, cognitive impairment, and dementia: a systematic review and meta-analysis. JAMA Otolaryngol Head Neck Surg 2018; 144: 115-126.