The Effect of 12-Week Xinyi Liuhe Quan Exercise on BDNF, NGF and Stroop Test Scores of Female College Students

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Abstract: To investigate the effect of 12-week exercise on neurotrophic factors (BDNF, NGF and Stroop) in female college students. 16 healthy female college students from Z University were recruited to participate in this experimental study. The subjects were divided into control group (N= 8) and exercise group (N= 8). The sports group conducted 5 times a week (Monday to Friday), 60 minutes of sports training each time, The RPE levels ranged from 12 to 15. The exercise intervention program included: warm-up exercise (10 min), basic part (40min), and relaxation exercise (10min), Statistical analysis of the test data was performed using Two-way ANOVA with repeated measure. Results: 1) Changes in BDNF. At 2.23 ng/ml before exercise and 2.58 ng/ml after exercise, time and group interaction effect was significant (P <0.05), and serum BDNF concentration increased significantly before and after exercise (P <0.05); 2) NGF change. The group is 26.53pg/ml before exercise and 27.72pg/ml after exercise; 3) the change of Stroop score. As for Change in the Word test score，it was 60.42 before exercise and 70.12 after exercise, and the interaction effect of time and group was significant (P <0.05); Word test scores in the group increased significantly (P <0.05). As for change in Color test score, the group was 65.42 before exercise and 82.71 after exercise, the interaction effect between time and group was significant (P <0.05), and the group increased significantly (P <0.05. As for change in Word-Color test scores. The group was 61.12 before exercise and 68.37 after exercise. The interaction effect of time and group was significant (P <0.05), and the Word-Color test scores of the group before and after exercise increased significantly (P <0.05). 12 weeks of Xinyi Liuhequan exercise can have a positive intervention effect on brain-derived neurotrophic factor (BDNF) and Stroop test results in female college students, therefore, Xinyi Liuhe Quan exercise is an effective prescription.

Keywords: Xinyi Liuhe Quan; Female College Students; BDNF; NGF; Stroop

1. Introduction

Xinyi Liuhe Quan, also known as the heart boxing, for the traditional home boxing. According to historical records, Xinyi Liuhe Quan, initiated by Yongji County, Shanxi Province in the late Ming Dynasty and early Qing Province, has a development history of 400 years. In 2007, Zhoukou Xinyi Liuhe Quan was included in the first batch of provincial intangible cultural heritage list of Henan Province, and in 2008, it was included in the second batch of national intangible cultural heritage list. Zhoukou Xinyi Liuhe Quan has a complete technical system, pictographic meaning, mainly to imitate the movements of chicken, horse, bear, dragon, kite, tiger, monkey, swallow, snake, cat in ten animals, and to develop its shape and meaning. It has the profound Chinese traditional cultural connotation, as well as the unique value of fitness, health preservation, skill and attack. In the second half of 2019, Xinyi Liuhe Quan, as a local excellent sports culture inheritance project, officially became one of the university sports optional courses of Zhoukou Normal University. Scientific research proves that, In addition to preventing chronic metabolic diseases such as obesity, hypertension and diabetes, Can also promote beneficial changes in the internal environment, neurological function, Previous studies have mainly focused on exercise behavior, the prevention and treatment of chronic metabolic diseases; With the gradual deepening of exercise research in the field of brain science, Nerve growth factor (nerve growth factor, NGF) and brain-derived neurotrophic factor (brain-derived neurotrophic factor, BDNF) has been identified as a molecular biomarker of exercise-induced

neurophysiological effects, Motor modification of the brain has become a consensus in the field of scientific research.

Xinyi Liuhe Quan is the precious intangible cultural heritage of the Chinese nation, and it is the wisdom crystallization of the ancient Chinese people to strengthen their body, resist disease and improve their immunity. Xinyi Liuhe Quan provides a Chinese characteristic solution for the development of the field of sports prescription in the world today. But looking through existing studies, At present, the empirical research on the intervention effect of cerebral nerve function after traditional sports exercise for Chinese female college students needs further research, Especially in the context of excellent traditional sports entering the campus and classroom, The lack of empirical studies on the intervention effect of traditional sports programs, So far, Few studies on the effects of Nboxing on brain activation, cognitive function and changes in neurotrophic factors, The mechanism of long regular training on the activity of cerebral neurotrophic factors and cognitive function is unclear; therefore, This study aimed to investigate the effect of 12-week exercise on neurotrophic factors (BDNF, NGF and Stroop) in female college students. The research results are expected for female college students Xinyi Liuhe Quan intervention effect provide experimental data support, and to improve the health level of female college students, provide sports in the field of sports science, at the same time research for the promotion of excellent sports, enhance national sports culture self-confidence and improve the value of traditional sports identity, has a very important theoretical value and practical significance.

2. Objects and Methods

2.1 Study Subjects

Sample sizes were calculated using G * Power version 3.1.9.7. The experimental design was 2 (group) * 2 (time point). Through the preliminary experiment, effect size was set to 0.35, power (1- βerr prob) was 0.8 and αerr prob was 0.05. The statistical analysis was Two-way ANOVA with repeated measure, the sample size was determined by 16 participants through G * Power, and the subjects were divided into exercise group and control group, with 8 in each group (n=8).

Sixteen healthy female college students from Z University were recruited to participate in this experimental study. Inclusion criteria: did not participate in the regular exercise program for the last six months or more, no serious illness or long-term drug use, volunteered to participate in the experiment. The study informed consent and study participation consent were signed before the experiment. The physical characteristics of the subjects are shown in Table 1.

2.2 Xinyi Liuhe Quan Intervention Program

In this study, full-time teachers from Z city are invited to give lectures. The routines, practice requirements and teaching guidance of Z Xinyi Liuhe Quan are subject to the teaching of local excellent traditional inheritors of Z City universities, 5 times a week (from Monday to Friday), 60 minutes each time for a total of 12 weeks. The exercises include: 1) prepare to practice for 10 minutes; 2) practice for 40 minutes; 3) relax for 10 minutes, a total of 60 minutes. The exercise intensity was controlled as moderate or above intensity, between RPE 12 and 15, so that the heart rate of the test subjects was controlled between 75 and 85% HR max.

Table 1. Physical Characteristics of the Subject Subjects [a]

	control group	Exercise group	P[b]
Age（years）	19.36±1.23	19.76±0.87	0.332
Height(cm)	162.32±3.71	164.52±6.09	0.817
Weight(kg)	58.16±1.85	59.31±4.22	0.835

[a] Mean±SD

[b] Independent t-test, compared with control group.

2.3 BDNF and Stroop Measurement Methods

2.3.1 The BDNF and NGF detection method

After 12 hours of fasting, blood samples were drawn from the forearm vein, centrifuged at 3000rpm for 10 minutes and stored at-80°C and directly for analysis; serum BDNF levels were analyzed using the R & D system (Minneapolis, Minn, USA) kit, and by enzyme-linked immunosorbent assay (enzyme linked immunosorbent assay, ELISA) (Abcam, MA, USA) for quantitative human NGF.

2.3.2 Stroop Determination method

Cognitive testing was performed by using the stroop test. The Stroop test (Word test, Color test, and Word-Color test) consists of three parts, requiring participants to read a list of items as quickly and accurately as possible in the 45S. The word test required subjects to read three

printed words from one page: red, green, and blue. The words were printed in black ink and randomly arranged in five columns of 20 words each, in which two same words were not allowed to appear adjacent. The color test also consisted of 100 items, written as XXXX and printed in red, green, or blue ink, with subjects needing to state the color of the ink for each X of the four X series. The color-word test, including the same 100 words (green, red or blue) as the first test, but printed with color ink, the ink color and the printed words differ, asked the subject to tell the ink color of the printed word instead of printing the word itself. In the three tests, the higher the score, the better the cognitive function of the subjects.

2.4 Statistical Methods

Two-factor repeated measures analysis of variance (Two-way ANOVA with repeated measure) was performed using SPSS26.0 software; with interaction effect ($P < 0.05$), paired sample T-test (Paired Samples t-test) within the group and independent sample T-test between different groups at the same time point. The significance level (α) in this study was set at 0.05.

3. Results

3.1 Changes in the BDNF

3.1.1 Changes in neurotrophic factor (BDNF)

In the changes of BDNF over time in different groups, the group was 2.23 ng/ml before exercise and 2.58 ng/ml after exercise, increasing 0.35 ng/ml after exercise, while the control group was 2.32 ng/ml before experiment and 2.28 ng/ml after 12 weeks, with a decrease of 0.04 ng/ml.

3.1.2 Change in NGF

In the change of NGF in different groups over time, the exercise group was 26.53pg/ml before exercise and 27.72pg/ml after exercise, which increased by 1.19 pg/ml, while the control group was 26.65pg/ml before the experiment and 25.17pg/ml after 12 weeks, with a decrease of 1.48 pg/ml.

3.2 Change in Stroop test scores

3.2.1 Word test Score change

Among the changes in Word test scores in different groups, the group was 60.42 before exercise and 70.12 after exercise, up 9.7, and the control group was 59.35 before experiment and 58.61 after 12 weeks, which decreased 0.74.

3.2.2 Color test Score change

Among the changes of Color test scores in different groups, the group was 65.42 before exercise and 82.71 after exercise, up 12.79, while the control group was 66.37 before the experiment and 65.42 after 12 weeks, a decrease of 0.95.

3.2.3 Change in the Word-Color test scores

Among the changes in Word-Color test scores in different groups, the group was 61.12 before exercise and 68.37 after exercise, up 7.25, while the control group was 62.28 before experiment and 63.12 after 12 weeks, an increase of 0.84.

Table 2. Statistical Table of Measurements before and after BDNF Experiments

Index	Group	Pre	Post-12	F-value		
				G	T	G×T
BDNF	Control	2.23±.31	2.35±.51	0.547	3.158*	4.551*
	Exercise	2.32±.33	2.28±.34			

Table 3. Statistical table of Measurements before and Post Measurement of NGF Experiment

Index	Group	Pre	Post-12	F-value		
				G	T	G×T
NGF	Control	26.53±.33	27.72±1.23	0.419	3.625	4.331
	Exercise	26.65±1.20	25.17±.1.32			

Table 4. Word test Statistics of the Measurements before and after the Experiment

Index	Group	Pre	Post-12	F-value		
				G	T	G×T
Word test	Control	60.42±5.335	70.12±6.741	0.557	5.223*	4.219*
	Exercise	59.35±7.352	58.61±4.225			

Table 5. Color test Statistics of Measurements before and after the Experiment

Index	Group	Pre	Post-12	F-value		
				G	T	G×T
Color test	Control	65.42±6.12	82.71±5.61	0.445	3.562*	4.335*
	Exercise	66.37±5.22	65.42±6.39			

Table 6 Statistics of before and Post Measurements of Word-Color Test Experiments

Index	Group	Pre	Post-12	F-value		
				G	T	G×T
Word-Color test	Control	61.12±4.48	68.37±5.35	0.552	5.366*	3.823*
	Exercise	62.28±6.35	63.12±7.01			

4. Discussion

4.1 The influence of Xinyi Liuhe Quan Exercise on BDNF of Female College Students

Brain-derived neurotrophic factor (BDNF) is a protein in the human brain that is generated by the brain-derived neurotrophic factor gene. Brain-derived neurotrophic factor is one of the most prevalent neurotrophic factors in the central nervous system, and this factor is present in the human nervous system. BDNF is the most abundant protein in the brain, which can promote the growth of neurons (nerve cells) in the brain, and also promote the formation of synapses of nerve cells in the brain. Simply put, it's the nutritional protein that the brain needs. Studies have shown that the hippocampal gyrus, which controls memory in the brain, is particularly rich in BDNF and is also important for synapse growth and long-term memory. There have been many international studies showing that the lack of BDNF may cause some cognitive impairments, such as Alzheimer's, one of the common degenerative disorders. In addition, if you are in a state of stress or depression for a long time, it may also inhibit the secretion of BDNF in the brain, affect memory and cognitive function, and even lead to more serious problems such as autonomic nerve disorders or hippocampal atrophy.

The effect of exercise intervention on BDNF levels is influenced by variables such as type, intensity and frequency of exercise, The research field of exercise type mainly focuses on strength (resistance) and aerobic training, The results of the existing studies suggest that, Resistance intervention did not increase BDNF levels in serum [1-4], among, Goekint et al [1] and Levinger et al [2] evaluated the 10 weeks of resistance training time, The duration of resistance training in the study of Schiffer et al [3] was 12 weeks, Yarrow et al [4] used a 5-week resistance training period, The reason why resistance training did not alter serum BDNF levels in these studies may be related to the type and duration of resistance exercise (5-12 weeks), However, Knaepen et al [11] considered that the reason for no significant change was because the frequency of resistance training in the above study (three times a week) was less than five times a week, The overall exercise dose was insufficient.

Among the existing studies on human serum BDNF concentration, some studies show that aerobic training can significantly improve BDNF level [5-7], but there are also studies that found no significant difference in BDNF level of aerobic training intervention [8,9]. Since different studies used different subjects, training duration and frequency, it is difficult to determine the consistency of aerobic training effects on increasing BDNF, and exercise intensity. However, aerobic intervention programs at high intensity (heart rate reserve [HRR], 65-85%) and frequency (4-7 times per week instead of 2-3 times per week) were able to significantly increase BDNF levels.

In conclusion, the existing studies of aerobic or resistance resistance on changes in BDNF levels have more significant effects of aerobic training than resistance training, where aerobic training seems to be more influenced by exercise intensity and frequency factors, followed by duration.

In the 12-week intervention, the intensity and frequency of the previous studies (13-15; 75-85% HRmax) and frequency (5 times per week), these studies found that the serum concentration of BDNF increased after the long-term aerobic training intervention [2,20,26]. In this study, the serum level of BDNF concentration increased significantly in the exercise group before and after the 12-week training, which was consistent with the above findings. The reason is that the action technique of Xinyi Liuhe Quan is characterized by air gravity, strength and strength, and aerobic exercise includes a short period of time of rapid power force, so long-term regular exercise can significantly increase the serum BDNF concentration of exercisers.

4.2 The Influence of Xinyi Liuhe Quan Exercise on NGF of Female College Students

Nerve growth factor was originally identified as a survival factor for both sensory and sympathetic neurons in the developing nervous

system. NGF (nerve growth factor) plays an important role in the maintenance of sympathetic and sensory neurons as well as in biological activities including cell growth [10]. In adults, NGF is not essential for survival, but it plays a crucial role in pain and hyperalgesia in some acute and chronic pain states, with higher expression of NGF in injured and inflamed tissues and activation of NGF receptor tyrosine kinases on injured neurons triggering and enhancing pain signaling through multiple mechanisms. Existing related to healthy individuals as the object of NGF related study results Schulz et al. [9] evaluated long-term regular exercise intervention related study results show that multiple sclerosis (MS) patients with 8 weeks of aerobic exercise intervention, training group serum NGF level is no significant difference, Bansi et al [11] in middle-aged MS patients, after 3 weeks of regular exercise (water exercise) intervention study subjects serum NGF level did not significantly change. However, a domestic study showed a significant taurine administration-dependent increase in NGF expression in the hippocampal gyrus of rats receiving an 8-week swimming exercise [12].

In the 12-week intervention study, there was no significant change in resting serum NGF levels after the 12 weeks; this finding was consistent with previous [9] studies. Considering the results of [9,11], it is difficult to improve serum NGF levels by short-term training, so it is necessary to explore the changes in serum NGF levels through long-term training in future studies of exercise interventions.

4.3 The Influence of the Xinyi Liuhe Quan Exercise on the Stroop Test Results of Female College Students

Exercise can promote brain development and function and improve brain health, but the mechanism is still not fully elucidated. In recent years, Chinese scholars have studied the target molecules and mechanisms of exercise and brain health from multiple angles and levels, analyzed the epigenetic mechanism of exercise antianxiety, and explored the neurobiological mechanisms of exercise in improving Alzheimer's disease and Parkinson's disease, as well as improving cognitive ability and addictive behavior in the elderly. Chen Aiguo et al. [12] proposed that sports can improve the brain intelligence of children and adolescents by intervening in movement load, movement skills, situational interaction and mental state, And thus puts forward to re-understand the role of sports, explore the new mode of "physical and health integration" to improve the brain intelligence of children and adolescents, and carry out the practical research of physical education to improve the brain intelligence of children and adolescents, Fang Liming [13] found that physical exercise significantly improved the cognitive ability of adolescent students, And played the function of promoting the fairness of educational effect, Finally, it has effectively improved the academic performance of young students, Bai super [14] found that appropriately increasing sports time per week could significantly improve the academic performance of children and adolescents.

Stroop The effect stems from an experiment conducted by American psychologist John Ridlay Stroop in 1935. It refers to the phenomenon that when the subject was asked to determine the color of a color word, when the color and the meaning of the word, the two stimulus dimensions were inconsistent, compared with the neutral situation or the consistent situation. A large number of studies found that there are many factors affecting the Stroop effect, such as context factors, operation task, color recognition ability, the age of the subjects, the proportion of words and non-words, and the amount of SOA.

Existing exercise interventions regarding Stroop color and word test performance studies can be classified as one-time exercise [15, 16] and studies of regular exercise [17-19], Forms of exercise such as aerobic training and resistance training have been shown to improve cognitive function, The improvement of human cognitive function by long-term regular physical exercise is associated with BDNF levels, After 5 weeks of aerobic exercise on subjects in the study by Griffin et al [15], Cognitive function increases with increasing serum BDNF levels, Thus demonstrating that the improvement in BDNF levels is highly correlated with increased cognitive function, The Stroop test in a 12-week study of the exercise intervention, The purpose is to explore the changes of the cognitive function after 12 weeks of Xinyi Liuhe Quan exercise; In this study, the interaction effect of time and group in the control and movement groups before and after the experiment, Compared with the control group, Both the word and color scores increased

significantly after 12 weeks, It shows the positive effect of the 12-week voluntary boxing exercise intervention on cognitive function. The results of this study are consistent with the results of the previous study [17], significantly increasing serum BDNF level and Stroop performance after 12 weeks of the exercise intervention, which proved the effectiveness of the intervention for improving the cognitive ability of the experimental subjects from the level of physiological and psychological indicators.

5. Conclusion

12 weeks of voluntary Xinyi Liuhe Quan exercise can help male college students with brain-derived neurotrophic factors (brain-derived neurotrophic factor, BDNF), nerve growth factor (nerve growth factor, NGF) and Stroop test performance played a positive intervention effect, In particular, the NGF concentration and Word-Color test score, therefore, The exercise is an effective exercise prescription, Can have a positive effect on the brain-derived neurotrophic factor (BDNF), nerve growth factor (NGF) and Stroop test scores of college students, Application in the field of adolescent physical and mental health promotion.

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