Scientific Research Publishing

Health, 2022, 14, 921-930
https://www.scirp.org/journal/health
ISSN Online: 1949-5005
ISSN Print: 1949-4998

Effects of Water Weight-Loss Walking Training on Lower Limb Motor Function and Gait in Stroke Patients

Jingbin Dou, Mengxuan Jiang

Qingdao Special Servicemen Recuperation Center of PLA Navy, Qingdao, China
Email: djb818@sina.com

How to cite this paper: Dou, J.B. and Jiang, M.X. (2022) Effects of Water Weight-Loss Walking Training on Lower Limb Motor Function and Gait in Stroke Patients. *Health*, **14**, 921-930.
https://doi.org/10.4236/health.2022.148065

Received: July 6, 2022
Accepted: August 20, 2021
Published: August 23, 2021

Abstract

Background: Water weight-loss walking training is an emerging physical therapy technique, which provides new ideas for improving the motor function of stroke patients and improving the quality of life of patients. However, the rehabilitation effect of water weight-loss training in stroke patients is currently unclear. **Objective:** To analyze the effect of water weight loss walking training in stroke patients. **Methods:** A total of 180 stroke patients admitted to our hospital from January 2019 to December 2021 were selected and randomly divided into two groups. The control group received routine walking training, and the research group performed weight loss walking training in water on this basis. The lower limb motor function, muscle tone grade, daily living ability, gait and balance ability were compared between the two groups before and after treatment. **Results:** Compared with the control group, the FMA-LE score (Fugl-Meyer motor assessment of Lower Extremity), MBI score (Modified Barthel Index) and BBS score (berg balance scale) of the study group were higher after treatment, and the muscle tone was lower ($P < 0.05$). After treatment, the stride length, stride speed and stride width in the two groups were increased compared with those before treatment, and the stride length, stride speed and stride width in the study group after treatment were higher than those in the control group ($P < 0.05$). Comparison of the maximum angle of flexion and extension of hip and knee between the two groups, $P < 0.05$. **Conclusion:** Water weight loss walking training can enhance patients' muscle tension, correct patients' abnormal gait, improve patients' balance and walking ability, and contribute to patients' motor function recovery and self-care ability improvement.

Keywords

Stroke, Water Weight Loss Walking Training, Balance Ability,

Three-Dimensional Gait Analysis, Lower Limb Motor Function

1. Introduction

Patients with stroke often have sequelae of varying degrees, such as hemiplegia of lower limbs, cognitive impairment and speech impairment, among which lower limb motor function is the main factor affecting patients' self-care ability [1]. Therefore, how to effectively restore the lower limb motor function of patients is very important. In terms of rehabilitation treatment, traditional walking training advocates decomposition training of all components of walking, including balance, stepping and weight bearing, etc., which may easily lead to sufficient separation exercise but poor actual exercise effect [2]. As an important means of rehabilitation, walking training for weight loss can integrate all components of walking organically and emphasize the training of all components of walking in the real environment [3]. Studies have reported that weight-loss walking training is of great significance to the improvement of patients' walking ability and the maintenance of normal walking ability [4]. A systematic review by Hu Nannan [5] *et al.* found that water exercise is quite safe and has been proven to improve balance function, mobility and muscle strength in stroke patients. GIURIATI [6] *et al.* found that water exercise intervention can improve the MBI score of stroke patients. Saquetto [7] *et al.* found that the BBS score improved more in patients with water exercise combined with land exercise. To better understand the effect of water weight-loss walking training in stroke patients, 180 stroke patients were selected in this paper, and the effect of weight-loss walking training was studied as follows:

2. Materials and Methods

2.1. Participants

Stroke patients admitted to the Comprehensive Treatment Department of Qingdao Special Service Sanatorium Center from January 2019 to December 2021 were selected. Statistical power was calculated a priori using G Power software for sample size calculations. Inclusion criteria: 1) All of them are in line with the relevant diagnostic criteria in "Main Points of Diagnosis of Various Cerebrovascular Diseases" [8]; 2) The vital signs were stable; 3) All cases were the first onset; 4) All of them had physical dysfunction. Exclusion criteria: 1) Serious heart and lung diseases; 2) Deterioration of the condition, with new cerebral infarction or cerebral hemorrhage lesions; 3) Patients with bone and joint diseases of lower limbs; 4) Severe cognitive dysfunction; 5) Others who cannot cooperate with walking training.

2.2. Methods

The control group was given routine walking training, and the patients were instructed to carry out range of motion training for lower limb joints. For the muscle groups with higher muscle tension, the muscle tension could be reduced by pulling. Guide patients to carry out basic training of lower limbs such as muscle strength, coordination, balance, sensation and posture adaptability training; The training was performed once a day and five times a week, including standing step, lateral step and weight bearing on one leg.

On the basis of the above, the research team gave medical hydrotherapy weight-loss walking training. Keep the water temperature at about 35˚C. The water depth is from the umbilical to the xiphoid process. According to the specific situation of the patient, the speed, rest time and times should be adjusted reasonably so that the patient can relieve fatigue consciously. The training time was half an hour a day, once a day, five times a week, and the training time of both groups was 3 months.

Both groups were evaluated by three dimensional motion capture and analysis system (Model: LaiTronic). After entering the gait analysis room, the patient wore only light tops and shorts and no shoes. Before the test begins, prepare for 5 minutes and familiarize yourself with the test process. The temperature of the test room is suitable. After preparation for the activity, infrared markers were pasted at 11 points, including the bilateral greater trochanter of femur, lateral condyle of femur of bilateral knee joint, bilateral lateral malleolus, bilateral calcaneal tuberosity, bilateral posterior superior iliac spine to iliac crest and sacrum. Patients were asked to walk a distance of more than 5 m at a comfortable speed for 4 times. The first gait data was removed and the average value of the next three gait data was included in the analysis.

2.3. Observation Indicators

1) Lower limb motor function: The lower limb part (FMA-LE) of fuGL-Meyer Scale [9] was scored with a total score of 34, and the higher the score, the better.

2) Balance ability: BBS scale [10] was used for evaluation, and the higher the score, the better.

3) Ability to live in daily life: The modified Barthel index (MBI) [11] was used to evaluate. The total score was 100, and the higher the score, the better.

4) Muscle tension grading: The modified Ashworth spasm [12] evaluation was used to grade the muscle tension of patients before and after treatment, which was divided into 0 - 4 grades, of which 0 was normal and 4 was the affected part was stiff or unable to move. The higher the grading was, the worse the muscle tension was.

5) Three dimensional gait assessment: Three dimensional motion capture and analysis system was used to measure the stride length, step width and step speed of the two groups before and after treatment, and compare the maximum Angle of hip and knee flexion extension between the two groups.

2.4. Statistical Methods

SPSS23.0 was used to analyze the data. T and X^2 tests were performed on measurement data ($\overline{x} \pm S$) and counting data (%), and rank sum test was performed on grade data. P < 0.05 suggested significant difference.

3. Results

3.1. Comparison of Baseline Data of Two Groups of Patients

Among the 180 patients, 99 were males and 81 were females, aged 48 - 75 years, with an average of (54.21 ± 3.89) years. According to random number table method, the patients were divided into two groups, 90 cases in each group. Comparison of general data between the two groups, P > 0.05. See Table 1.

3.2. Comparison of Functional Recovery and Self-Care Ability between the Two Groups

Before and after treatment, the FMA-LE score (20.78 ± 2.93) vs (28.95 ± 3.74), the BBS score (12.75 ± 3.79) vs (16.68 ± 4.34) and the MBI score (62.68 ± 4.72) vs (82.75 ± 6.87) in the observation group had significant changes. Statistical significance, the control group FMA-LE score (20.83 ± 2.85) vs (26.48 ± 3.29), BBS score (12.69 ± 3.81) vs (14.72 ± 3.98) and MBI score (63.20 ± 4.57) vs (63.20 ± 4.57) changes It was also statistically significant, and the scores in the observation group were higher than those in the control group after treatment (P < 0.05). As shown in Table 2.

Table 1. Comparison of baseline data between the two groups.

Group	N	Gender (n/n)	Age ($\overline{x} \pm s$, annum)	Course of the disease ($\overline{x} \pm s$, annum)	Disease types (n/n)	Pathological changes (n/n)
		Male/female			Cerebral hemorrhage/ cerebral infarction	Left/right
Observation group	90	49/41	54.78 ± 3.82	2.85 ± 0.42	44/46	48/42
Control group	90	50/40	53.96 ± 3.87	2.91 ± 0.38	43/47	46/44
χ^2/t value			1.431	1.005	0.022	0.089
P *value*			0.154	0.316	0.881	0.765

Table 2. Comparison of FMA-LE, BBS and MBI scores between the two groups ($\overline{x} \pm s$).

Group	n	FMA-LE score		BBS score		MBI score	
		Prior treatment	Posttreatment	Prior treatment	Posttreatment	Prior treatment	Posttreatment
Observation group	90	20.78 ± 2.93	28.95 ± 3.74*	12.75 ± 3.79	16.68 ± 4.34*	62.68 ± 4.72	82.75 ± 6.87*
Control group	90	20.83 ± 2.85	26.48 ± 3.29*	12.69 ± 3.81	14.72 ± 3.98*	63.20 ± 4.57	76.94 ± 5.29*
T value		0.116	4.704	0.106	3.158	0.751	6.357
P value		0.908	<0.001	0.916	0.002	0.454	<0.001

Note: Compared with before treatment, *P < 0.05.

3.3. Comparison of Muscle Tension Grades between the Two Groups

Before treatment, the muscle tension grade of the two groups was compared, P > 0.05; the muscle tension grading of the study group was better than that of the control group (P < 0.05). See Table 3.

3.4. Comparison of Stride Length, Pace and Stride Width between the Two Groups

Before and after treatment, the stride length (0.42 ± 0.15) vs (0.79 ± 0.27), stride speed (0.25 ± 0.13) vs (0.65 ± 0.34) and stride width (0.27 ± 0.09) vs (0.20 ± 0.11) in the observation group were statistically significant The changes in stride length (0.41 ± 0.17) vs (0.65 ± 0.23), pace (0.27 ± 0.11) vs (0.49 ± 0.28) and stride width (0.26 ± 0.12) vs (0.21 ± 0.08) in the control group were also statistically significant. Compared with the control group, the stride length and stride speed of the study group after treatment were significantly different (P < 0.05). See Table 4.

3.5. Comparison of Range of Motion between the Two Groups

The maximum angle of hip flexion (6.71 ± 0.85) vs (20.58 ± 4.64), the maximum angle of hip extension (8.24 ± 1.15) vs (23.65 ± 5.57), the maximum angle of knee flexion (7.82 ± 1.14) vs (24.18 ± 4.26) in the observation group before and after treatment, the maximum angle of knee extension (9.15 ± 2.46) vs (28.76 ± 5.12) were statistically significant. In the control group, the maximum angle of hip flexion (6.74 ± 0.82) vs (15.62 ± 3.87), the maximum angle of hip extension (8.29 ± 1.08) vs (18.86 ± 4.18), the maximum angle of knee flexion (7.79 ± 1.23) vs (19.86 ± 3.79), and the maximum angle of knee extension (9.21 ± 2.38) vs (23.45 ± 4.2) were also statistically significant, and the study group The maximum angles of hip and knee flexion and extension were greater than those of the control group (P < 0.05). As shown in Table 5.

Table 3. Comparison of muscle tension grades between the two groups [N (%)].

Time	Grouping	*n*	0 level	1 level	2 level	3 level	4 level
Prior treatment	Observation group	90	0	15	39	24	12
	Control group	90	0	16	37	26	11
	Z value				0.041		
	P value				0.968		
Posttreatment	Observation group	90	11	29	30	15	5
	control group	90	5	23	32	22	8
	Z value				2.040		
	P value				0.042		

Table 4. Comparison of stride length, pace and step width between the two groups before and after treatment ($\bar{x} \pm s$).

Grouping	n	Stride (m)		Pace (m/s)		Step width (m)	
		Prior treatment	Posttreatment	Prior treatment	Posttreatment	Prior treatment	Posttreatment
Observation group	90	0.42 ± 0.15	0.79 ± 0.27*	0.25 ± 0.13	0.65 ± 0.34*	0.27 ± 0.09	0.20 ± 0.11*
Control group	90	0.41 ± 0.17	0.65 ± 0.23*	0.27 ± 0.11	0.49 ± 0.28*	0.26 ± 0.12	0.21 ± 0.08*
t value		0.418	3.745	1.114	3.877	0.632	0.697
P value		0.676	<0.001	0.267	0.001	0.528	0.486

Note: Compared with before treatment, *P < 0.05.

Table 5. Comparison of hip and knee flexion extension activity between the two groups before and after treatment ($\bar{x} \pm s$).

Grouping	n	Maximum Angle of hip flexion		Maximum Angle of hip extension		Maximum Angle of knee flexion		Maximum Angle of knee extension	
		Prior treatment	Posttreatment	Prior treatment	Posttreatment	Prior treatment	Posttreatment	Prior treatment	Posttreatment
Observation group	90	6.71 ± 0.85	20.58 ± 4.64*	8.24 ± 1.15	23.65 ± 5.57*	7.82 ± 1.14	24.18 ± 4.26*	9.15 ± 2.46	28.76 ± 5.12
Control group	90	6.74 ± 0.82	15.62 ± 3.87*	8.29 ± 1.08	18.86 ± 4.18*	7.79 ± 1.23	19.86 ± 3.79*	9.21 ± 2.38	23.45 ± 4.26
T value		0.241	7.788	0.301	6.525	0.170	7.188	0.166	6.731
P value		0.809	<0.001	0.764	<0.001	0.865	<0.001	0.868	<0.001

4. Discussion

For stroke patients, rehabilitation treatment is very important both for functional recovery and for reducing the burden on families and society. The recovery of lower limb motor function and gait is of great significance to the functional independence of patients. Stroke can damage the neurological function of patients, lead to functional disorders such as limb paralysis, and seriously reduce patients' self-care ability [13]. Patients with post-stroke hemiplegia, due to their own motor dysfunction, will lead to abnormal gait, thus increasing the risk of falls and affecting the quality of life of patients [14]. Therefore, how to effectively improve the lower limb motor function of stroke patients and enhance their walking ability has become the primary goal of stroke rehabilitation treatment [15] [16] [17]. With the continuous progress of rehabilitation therapy, the methods that can be applied to the recovery of limb function of stroke patients are more diversified.

Routine walking rehabilitation training mainly improves patients' basic walking ability through basic training and decomposition training [18]. However, walking is a dynamic and continuous process, which requires not only muscle strength but also overall coordination, while conventional walking training often fails to achieve this effect [19]. Weight training on foot through the use of suspension device or the buoyancy of water, can to a certain extent, reduce the body weight of patients with lower limb weight, at the same time, the therapist can beside to help, for patients with hemiplegia early balance and walking ability training to create a good condition, effectively improve the patient's body coordination, make its more natural gait [20].

Many clinical practices have shown that weight-loss walking training can organically combine stride, balance, weight bearing and other factors to help patients establish a normal gait pattern, which is increasingly widely used in clinical treatment [21] [22] [23] [24]. Zeng Ming *et al.* [25] found that water treadmill training could improve the walking function of stroke patients through routine water exercise training in the control group and treadmill walking training in water in the treatment group. Studies have found that water platform training significantly improves lower limb motor function, walking speed and walking ability of stroke patients [26]. Wang Jun *et al.* [27] believed that treadmill walking training in water can improve motor function and walking ability of stroke patients. Wang Li [28] adopted 6-week intensive walking training in water for stroke patients with hemiplegia, and found that early rehabilitation training combined with intensive walking training in water had a significant recovery effect on walking ability, which was superior to conventional rehabilitation training.

Water buoyancy can partially compensate for the insufficient muscle strength of the flexion hip muscle group in the stride phase of the affected lower limb, reduce the pathological abduction and external rotation of the hip, and improve the symmetry of gait [29]. Water flatbed training not only causes changes in exercise load, but also affects the movement mode, so it is more suitable for gait training [30]. The results of this study showed that the fMA-LE, BBS and MBI scores of the study group were higher than those of the control group, and the improvement of muscle tone grade, stride length, stride speed, stride width and range of motion were better than those of the control group ($P < 0.05$). The results showed that the training mode in the study group was more helpful to improve the patients' motor function, improve their muscle tension, enhance their balance and coordination ability, correct their abnormal gait, and enhance the stability of knee and hip joints, thus accelerating the recovery of lower limb function and improving the patients' ability to live.

The limitations of this study are that no follow-up was performed, and no group intervention was performed according to the different recovery periods of stroke patients. Future studies can take this limitation into account and improve.

5. Conclusion

In conclusion, the effect of water weight loss walking training promoted in stroke patients is significant, which can significantly improve patients' muscle strength, balance ability and walking ability, and promote the improvement of lower limb function, thus optimizing patients' prognosis.

Foundation

The national key project of the 13th five-year plan of the National Health and

Family Planning Commission (YYWS1107), and the Qingdao Medical and health research program (WJZD258)

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Wang, Y.N., Liu, H.L. and Du, X.J. (2022) Efficacy of Water Plank Walking Training on Postural Control and Gait Symmetry in Convalescent Stroke Patients with Hemiplegia. *China Rehabilitation*, No. 3, 140-144. (In Chinese)

[2] Zhao, Q.Y., Lin, Q. and Yang, T. (2018) Effects of Weight Loss Walking Training and Muscle Tension on the Recovery of Lower Extremity Motor Function in Stroke Patients. *Chinese Journal of Physical Medicine and Rehabilitation*, No. 11, 821-825. (In Chinese)

[3] Wang, R.L. and Bai, D.Q. (2018) Effects of Weight Loss Walking Training on Glucose Tolerance in Elderly Patients with Stroke. *Chinese Journal of Gerontology*, No. 1, 174-175. (In Chinese)

[4] Jung, S.H., Song, S.H., Lee, D.G., *et al.* (2020) Effects of Kinect Video Game Training on Lower Extremity Motor Function, Balance, and Gait in Adolescents with Spastic Diplegia Cerebral Palsy: A Pilot Randomized Controlled Trial. *Developmental Neurorehabilitation*, **24**, 159-165. https://doi.org/10.1080/17518423.2020.1819458

[5] Hu, N.N., Guo, H., Lin, K.K., *et al.* (2022) Re-Evaluation of a Systematic Review of the Rehabilitation Effect of Water Exercise Therapy on Stroke Patients. *Chinese General Medicine*, No. 19, 2421-2428. (In Chinese)

[6] Giuriati, S., Servadio, A., Temperoni, G., *et al.* (2020) The Effect of Aquatic Physical Therapy in Patients with Stroke: A Systematic Review and Meta-Analysis. *Topics in Stroke Rehabilitation*, **28**, 19-32. https://doi.org/10.1080/10749357.2020.1755816

[7] Saquetto, M.B., Martinez, B.P., *et al.* (2019) Water-Based Exercise on Functioning and Quality of Life in Poststroke Persons: A Systematic Review and Meta-Analysis. *Journal of Stroke and Cerebrovascular Diseases*, **28**, Article ID: 104341. https://doi.org/10.1016/j.jstrokecerebrovasdis.2019.104341

[8] Chinese Neurological Association, Chinese Neurosurgical Association (1996) Diagnosis of Cerebrovascular Diseases. *Chinese Journal of Neurology*, **26**, 379-380. (In Chinese)

[9] Lu, R.R., Gao, T.H. and Zhang, J.J. (2018) Efficacy of Weight Loss Motor Control Training in the Context of Visual Feedback on Motor Function Improvement in Stroke Patients with Hemiplegia. *Chinese Journal of Sports Medicine*, No. 8, 652-656. (In Chinese)

[10] Zhang, B. and Wang, X.M. (2020) Effects of Weight Loss Walking Training Combined with Traditional Chinese Medicine Acupuncture on the Recovery of Limb Function in Stroke Patients with Hemiplegia. *Laboratory Medicine and Clinical*, No. 2, 258-260. (In Chinese)

[11] Mizuta, N., Hasui, N., Nakatani, T., *et al.* (2020) Walking Characteristics Including Mild Motor Paralysis and Slow Walking Speed in Post-Stroke Patients. *Scientific Reports*, **10**, Article No. 11819. https://doi.org/10.1038/s41598-020-68905-3

[12] Liu, Z. and Liang, T.J. (2021) The Effect of Mirror Therapy Combined with Weight Loss Plank Walking Training on the Improvement of Walking Function in Stroke Patients with Hemiplegia. *Chinese General Medicine*, No. 21, 2680-2685. (In Chinese)

[13] Youn, I. (2021) Prediction of Lower Extremity Multi-Joint Angles during Overground Walking by Using a Single IMU with a Low Frequency Based on an LSTM Recurrent Neural Network. *Sensors*, **22**, 53.

[14] Mengi, A., Sarikaya, S. and Ozdolap, S. (2020) The Effect of Mirror Therapy on Lower Extremity Motor Function and Ambulation in Post-Stroke Patients: A Prospective, Randomized-Controlled Study. *Turkish Journal of Physical Medicine and Rehabilitation*, **66**, 154-160. https://doi.org/10.5606/tftrd.2020.2719

[15] Y.-J., Xie, Chen, Y., Tan, H. X., Guo, Q.F., Lau, B.W.-M. and Gao, Q. (2021) Repetitive Transcranial Magnetic Stimulation for Lower Extremity Motor Function in Patients with Stroke: A Systematic Review and Network Meta-Analysis. *Neural Regeneration Research*, **16**, 170-178. https://doi.org/10.4103/1673-5374.300341

[16] Zhi, F. and Wu, X.X. (2018) Clinical Research on Early Partial Weight Loss Walking Training and Rehabilitation in Stroke Patients with Hemiplegia. *Contemporary Medicine*, No. 16, 162-164. (In Chinese)

[17] Miller, A., Reisman, D.S., Billinger, S.A., *et al.* (2021) Moderate-Intensity Exercise versus High-Intensity Interval Training to Recover Walking Post-Stroke: Protocol for a Randomized Controlled Trial. *Trials*, **22**, Article No. 457. https://doi.org/10.1186/s13063-021-05419-x

[18] Huang, W.Y., Li, M.H., Lee, C.H., *et al.* (2021) Efficacy of Lateral Stair Walking Training in Patients with Chronic Stroke: A Pilot Randomized Controlled Study. *Gait & Posture*, **88**, 10-15. https://doi.org/10.1016/j.gaitpost.2021.04.026

[19] Samuel, O.W., Asogbon, M.G., *et al.* (2021) Decoding Movement Intent Patterns Based on Spatiotemporal and Adaptive Filtering Method towards Active Motor Training in Stroke Rehabilitation Systems. *Neural Computing and Applications*, **33**, 4793-4806. https://doi.org/10.1007/s00521-020-05536-9

[20] Lee, J., Kim, H., Kim, J., *et al.* (2020) Differential Early Predictive Factors for Upper and Lower Extremity Motor Recovery after Ischemic Stroke. *European Journal of Neurology*, **28**, 132-140. https://doi.org/10.1111/ene.14494

[21] Lu, M.S. and Gao, H.L. (2021) Observation on the Application Effect of Weight Loss Walking Training in Patients with Hemiplegia in the Early Stage of Stroke. *Clinical Medicine Engineering*, No. 10, 1371-1372. (In Chinese)

[22] Yu, X.M., Jin, X.M., Lu, Y., *et al.* (2020) Effects of Body Weight Support-Tai Chi Footwork Training on Balance Control and Walking Function in Stroke Survivors with Hemiplegia: A Pilot Randomized Controlled Trial. *Evidence-Based Complementary and Alternative Medicine*, **2020**, Article ID: 9218078. https://doi.org/10.1155/2020/9218078

[23] Yao, J., Sado, T., Wang, W., *et al.* (2021) The Kickstart Walk Assist System for Improving Balance and Walking Function in Stroke Survivors: A Feasibility Study. *Journal of NeuroEngineering and Rehabilitation*, **18**, Article No. 42. https://doi.org/10.1186/s12984-020-00795-y

[24] Li, H., Li, Y., Gu, X.D., *et al.* (2022) Effects of Weight Loss Plank Training Combined with Functional Electrical Stimulation on Lower Extremity Motor Function and Walking Ability in Patients with Post-Stroke Hemiplegia. *Chinese Journal of Physical Medicine and Rehabilitation*, No. 3, 214-217. (In Chinese)

[25] Zeng, M., Cui, Y., Wang, Y.L., *et al.* (2019) Influence of Water Plank Walking Train-

ing on Walking Function in Stroke Patients. *Chinese Rehabilitation Theory and Practice*, No. 1, 76-80. (In Chinese)

[26] Jiang, W.Y. (2019) Effect of Underwater Treadmill on Lower Limb Motor Function in Convalescent Stroke Patients. Master's Thesis, Liaoning Normal University, Dalian. (In Chinese)

[27] Wang, J., Huang, B., Yang, Z.Y., *et al.* (2015) A Study on the Improvement of Walking Ability in Stroke Patients with Water Plank Walking Training. *Chinese Journal of Rehabilitation Medicine*, No. 7, 692-695. (In Chinese)

[28] Wang, L. and Dai, C.Q. (2014) Effects of Intensive Walking Training in Water on the Recovery of Walking Ability in Stroke Patients with Hemiplegia. *Chinese Journal of Rehabilitation Medicine*, No. 1, 76-78. (In Chinese)

[29] Jung, T., Lee, D.K., Charalambous, C., *et al.* (2010) The Influence of Applying Additional Weight to the Affected Leg on Gait Patterns during Aquatic Treadmill Walking in People Poststroke. *Archives of Physical Medicine & Rehabilitation*, **91**, 129-136. https://doi.org/10.1016/j.apmr.2009.09.012

[30] Wu, Q., Cong, F. and Song, G.Y. (2015) Effects of Water Treadmill Training and Weight Loss Treadmill Training on Walking and Balance Function in Stroke Patients with Hemiplegia. *Chinese Rehabilitation Theory and Practice*, No. 2, 207-211. (In Chinese)