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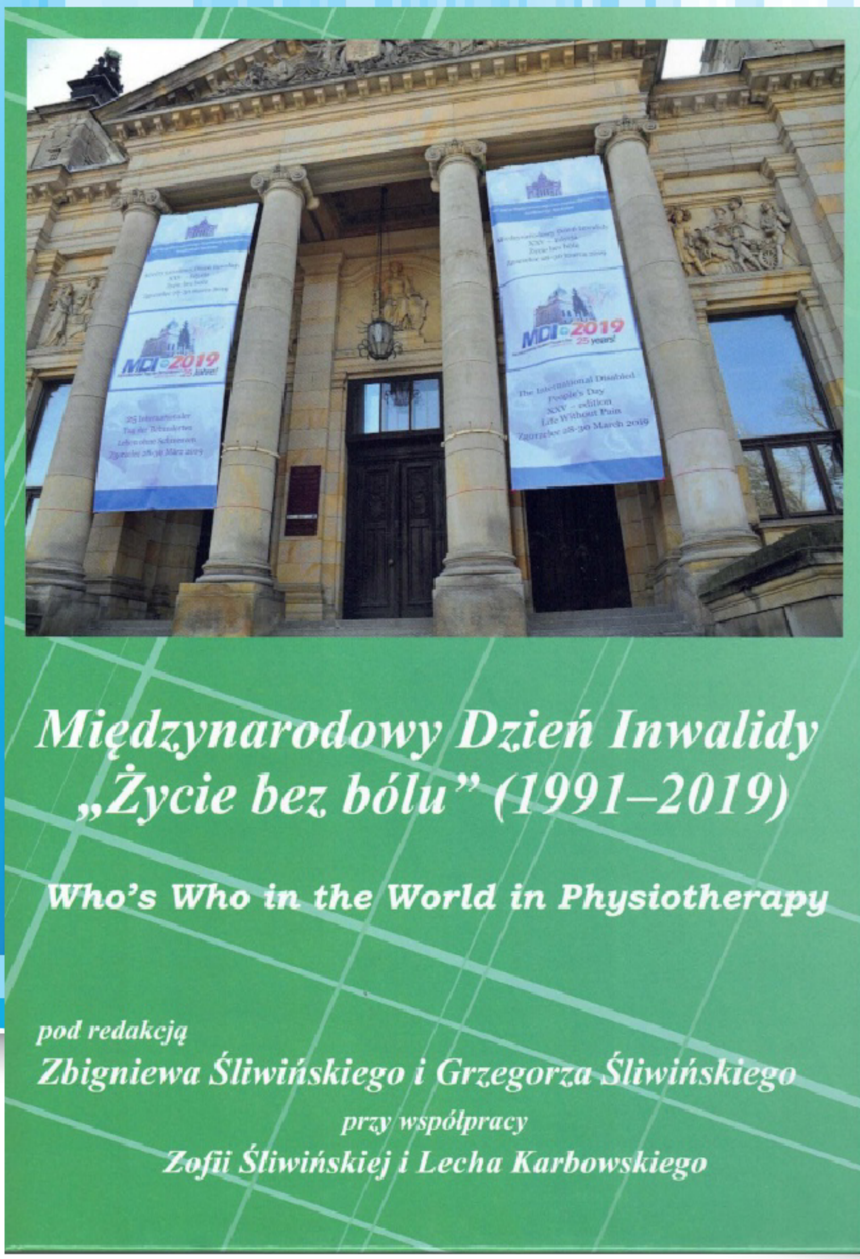

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Rozdział III - Udział naukowców polskich
Rozdział IV - Patronaty honorowe, udział polityków i samorządowców
Rozdział V - Patronaty naukowe
Rozdział VI - "Fizjoterapia bez granic" – studencka konferencja naukowa w ramach obchodów Międzynarodowego Dnia Inwalidy
Rozdział VII - Transgraniczny Uniwersytet Trzeciego Wieku w Zgorzelcu
Rozdział VIII - Artyści w obchodach Międzynarodowego Dnia Inwalidy
Rozdział IX - Najsłodsi sponsorzy obchodów MDI

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Comparing between the efficacy of underwater treadmill and over-ground treadmill training program on trunk kinematics in stroke patients: A randomized controlled trial

Porównanie skuteczności programu treningowego na bieżni podwodnej i naziemnej w zakresie kinematyki tułowia u pacjentów po udarze: randomizowane badanie kontrolowane

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Abstract

Background. Gait disorder is a common clinical problem for stroke survivors. Trunk movement, control and symmetry are important prerequisite for gait. Trunk kinematics rarely investigated during gait cycle. Objective. This study was conducted to compare between the efficacy of underwater treadmill training program (TTP) and over-ground (TTP) in improving trunk kinematics during the gait cycle of stroke patients. Study design. randomized control trial. Methods. Forty male patients suffering from post-stroke gait deficits were assigned randomly into two equal groups: study group (A): received underwater treadmill training program. Control group (B) received over-ground treadmill training program. Patients of both groups were assessed for trunk range of motion (ROM) during gait cycle using slow motion video and goniometer iPad application. Assessment was done before and after four weeks of treatment for both groups. Results. the comparison between groups post treatment showed a significant increase in trunk lateral flexion toward affected and significant decrease in trunk lateral flexion toward unaffected during stance phase with increase in trunk symmetry between both sides in the study group (A) compared with that of control group (B). Conclusion. under water TTP is more effective than over-ground TTP on improving trunk kinematics during the gait cycle of stroke patients.

Key words:

stroke, trunk kinematics, underwater treadmill, over-ground treadmill

Streszczenie

Informacje wprowadzające. Zaburzenia chodu są powszechnym problemem klinicznym u pacjentów po udarze. Ruch tułowia, kontrola i symetria są ważnymi warunkami chodu. Kinematyka tułowia była rzadko badana podczas chodu. Cel. Niniejsze badanie przeprowadzono w celu porównania skuteczności programu treningowego na bieżni podwodnej (TTP) i naziemnej (TTP) w poprawie kinematyki tułowia podczas chodu u pacjentów po udarze mózgu. Projekt badania. Randomizowane badanie kontrolne. Metody. Czterdziestu pacjentów płci męskiej cierpiących na deficyty ruchowe w zakresie chodu po udarze zostało losowo przydzielonych do dwóch równych grup: grupa badana (A): poddawana programowi treningowemu na bieżni podwodnej. Grupa kontrolna (B) poddawana programowi treningowemu na bieżni naziemnej. Pacjenci obu grup byli oceniani pod kątem zakresu ruchu tułowia (ROM) podczas chodu za pomocą wideo w zwolnionym tempie i aplikacji goniometru na iPada. Ocenę przeprowadzono przed i po czterech tygodniach leczenia dla obu grup. Wyniki. Porównanie między grupami po leczeniu wykazało znaczny wzrost bocznego zgięcia tułowia w stronę dotkniętą chorobą i znaczne zmniejszenie bocznego zgięcia tułowia w stronę przeciwną podczas fazy podparcia ze wzrostem symetrii tułowia po obu stronach w grupie badanej (A) w porównaniu z grupą kontrolną (B). Wniosek. Bieżnia podwodna jest skuteczniejsza niż bieżna nadziemna, jeśli chodzi o poprawę kinematyki tułowia podczas chodu u pacjentów po udarze.

Słowa kluczowe

udar, kinematyka tułowia, bieżnia podwodna, bieżnia naziemna

Introduction

Stroke is a major global health problem leading to mortality and chronic disability [1]. The global incidence of stroke is approximately 5.5 million deaths annually and 44 million disability years [2]. Hemiparetic walking is characterized by a slow and highly inefficient gait, which is a leading cause of disability [3]. The role of the trunk in mobility and stability is however often overlooked as an integral component of performing daily core functions such as walking after stroke [4].

Today, there is no specific therapeutic program concerned with trunk kinematics in stroke survivors. Over-ground walking is commonly associated with poor performance as result of fear of falling. The essential physical properties of water has great therapeutic benefits as it eliminates the gravitational force and so that the only forces that act on the limbs are the muscle torque. Viscosity and hydrostatic pressure are able to support a body, reduce the fear of falling, and encourage balance [5].

The previous studies have found that aquatic therapy can improve muscular strength, endurance, equilibrium ability, and cardiopulmonary endurance because it is less burdensome on the lower limbs. It can provide stable training for those affected with stroke compared with ground exercises and can be helpful for achieving psychological stability [6].

The previous systematic reviews summarized that the water-based exercise for neurological disorder covers a wide variety, including resistance training, movement facilitation, motor control training, balance training, coordination training and other specific techniques indicated that stroke patients improved significantly more in weight shifting ability, dynamic balance, and functional mobility as compared with the land-based intervention [7].

Aim

The aim of this study was to investigate the difference between underwater treadmill and over-ground treadmill training program (TTP) in improving trunk kinematics during the gait cycle of stroke patients.

Materials and Methods

Study design

This study was designed as a prospective, randomized, single-blind, pre–post-test, controlled trial. The research protocol has followed the tenets of the declaration of Helsinki, and has been approved by the Ethical Committees of faculty of physical therapy, Cairo University NO.P.T.REC/012/002182. Informed consent was obtained from each participant after explaining the study's nature, purpose and benefits, informing them of their right to refuse or withdraw at any time, and about the confidentiality of any obtained information. Anonymity was assured through coding of all data. The study was conducted between August 2019 till October 2020.

Participants

The current study was done on forty male patients suffering from post-stroke gait deficits. Inclusion criteria were: stroke patients could walk at least ten meters independently without the help of an assistive instrument, age of 45-60 years, body mass index (BMI) ranged from 22-30 kg /m2. The participants were excluded if they suffered acute or recurrent stroke, had shortening or contracture in lower limb flexors, moderate or severe spasticity as defined as modified Ashworth scale equal or greater than grade three, any cognitive or psychiatric disorders or other neurological diseases which would affect the results of this study and chronic neglected patients.

Randomization

A computer-generated randomized table was the method used to implement the randomization using the SPSS program (version 26 for Windows). Each participant had an identification number. These numbers were assigned into two groups equal in number. Sequentially numbered index cards were secured in opaque envelopes. A blinded researcher opened the sealed envelope and allocated the patients according to their groups (figure 1).

Interventions

Forty male patients with post-stroke gait deficits were included in the current study. The patients were recruited from local hospital and randomly divided evenly into two groups of twenty patients: study group A and control group B. Before enrollment, all participants were asked to read and sign a consent form that was approved by local ethical committee. Study group A. The patients received underwater treadmill training program in a therapy pool with a water depth adjusted to the chest level (Xiphoid process) by using movable floor pool [8]. The temperature of the water was adjusted to 34–36°C with an air temperature of 24°C, the program consisted of five minutes warm up-period followed by 30 minutes of strengthening, balance exercises and 15 minutes aquatic treadmill training (Begin at an individual's comfortable turning speed on level ground, increased by increments of 0.05 m/s every 5 minutes as tolerated), finally ten minutes Cool-down period. Control group B. The patients received over-ground treadmill training program consisted of five minutes warm up-period followed by 30 minutes of strengthening, trunk mobility exercises and 15 minutes over-ground treadmill training (Begin at an individual's comfortable turning speed on level ground, increased by increments of 0.05 m/s every 5 minutes as tolerated), finally ten minutes Cooling-down period [9]. Both groups received 12 sessions of treatment, three times per week for four weeks.

Outcome measures

All assessment methods were valid and reliable. All patients were passed into the following assessment: (I) trunk (ROM) during the gait cycle: by using slow motion video and goniometer iPad application: The iphone 6 plus camera adjusted to view the whole markers in sagittal and coronal plane, captured trunk flexion and extension from lateral view, trunk lateral flexion from posterior view during the gait cycle [10]. The video was taken while the patient walks on over-ground treadmill. The range of motion detected over the screen shoot by using iPad goniometer application [11].

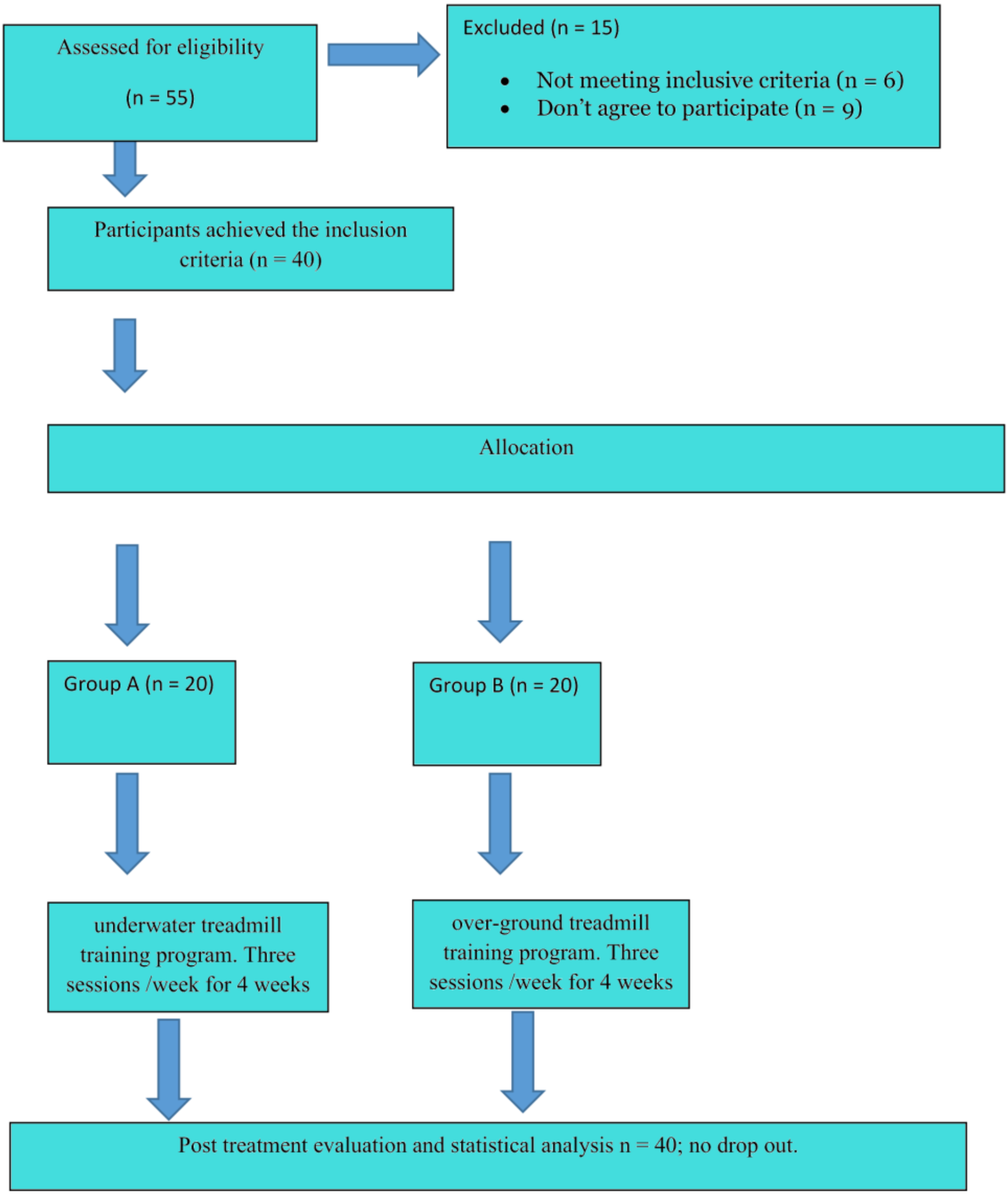

Figure 1. Flow chart of the study

Statistical Analysis

Descriptive statistics and unpaired t-tests were conducted for comparison of age between both groups. Normal distribution of data was checked using the Shapiro-Wilk test for all variables. Levene's test for homogeneity of variances was conducted to test the homogeneity of trunk ROM between the study and control groups. 2x2 mixed design MANOVA was conducted for comparison of trunk ROM between and within both groups. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA). The significance or alpha (α) level of the study was set to 0.05 (5%) [12, 13].

Results

Basic characteristics of the patients

Subject characteristics were demonstrated in table 1. There was no significant difference between groups in age, weight, height, BMI and duration of illness ($p > 0.05$).

Table 1. Demographic data of participants in all groups

	Group A (N = 20) Mean ± SD	Group B (N = 20) Mean ± SD	p-value
Age [years]	54.2 ± 6.29	52.45 ± 6.19	0.38
Weight [kg]	81.35 ± 9.83	80.4 ± 8.27	0.74
Height [cm]	168.6 ± 5.27	170.3 ± 5.12	0.3
BMI [kg/m²]	28.58 ± 2.84	27.75 ± 3	0.37
Duration of illness [months]	8.33 ± 2.35	8.66 ± 1.95	0.54

SD: standard deviation; p-value: Probability value

Effect of treatment on trunk flexion ROM in initial contact, trunk extension ROM in mid-stance and terminal stance and lateral trunk flexion ROM toward affected and unaffected sides

Mixed MANOVA revealed that there was a significant interaction of treatment and time (F = 9.23, p = 0.001). There was a significant main effect of time (F = 12.25, p = 0.001). There was a significant main effect of treatment (F = 6.67, p = 0.001). Within group comparison, there was no significant difference in trunk flexion in initial contact, trunk extension in mid-stance and terminal stance between pre and post treatment in the study and control groups (p > 0.05). There was a significant increase in lateral trunk flexion toward affected side and a significant decrease in lateral trunk flexion toward unaffected side post treatment compared with that pre-treatment in the study group (p > 0.01) while there was no significant change in that of the control group (p > 0.05) as shown in table 2.

Between groups of comparison, there was no significant difference between groups pre-treatment (p > 0.05). Comparison between groups post treatment showed a significant increase in lateral trunk flexion toward affected side and a significant decrease in lateral trunk flexion toward unaffected side of the study group compared with that of control group (p < 0.01). While there was no significant difference in trunk flexion in initial contact, trunk extension in mid-stance and terminal stance between groups post treatment (p > 0.05) as sown in table 2.

Table 2. Mean trunk flexion in initial contact, trunk extension in mid-stance and terminal stance and lateral trunk flexion toward affected and unaffected side pre and post treatment of the study and control groups

		Study group Mean ± SD	Control group Mean ± SD	p value
Trunk flexion in initial contact (degrees)	Pre treatment	10.01 ± 1.89	9.72 ± 1.64	0.6
	Post treatment	9.68 ± 1.98	9.35 ± 1.23	0.53
	p- value	p = 0.12	p = 0.09	
Trunk extension in mid stance (degrees)	Pre treatment	14.92 ± 4.18	14.76 ± 3.41	0.89
	Post treatment	14.72 ± 4.08	14.46 ± 3.45	0.82
	p- value	p = 0.25	p = 0.08	
Trunk extension in terminal stance (degrees)	Pre treatment	11.9.3 ± 3.27	11.66 ± 3.17	0.79
	Post treatment	11.54 ± 3.45	11.25 ± 2.74	0.77
	p- value	p = 0.12	p = 0.1	
Trunk lateral flexion toward affected side (degrees)	Pre treatment	5.41 ± 1.85	5.65 ± 1.46	0.65
	Post treatment	7.69 ± 2.22	5.95 ± 1.88	0.01
	p- value	p = 0.001	p = 0.33	
Trunk lateral flexion toward unaffected side (degrees)	Pre treatment	3.46 ± 2.81	3.59 ± 3.51	0.89
	Post treatment	-1.85 ± 1.73	3.55 ± 1.61	0.001
	p- value	p = 0.001	p = 0.95	

SD: standard deviation; p-value: probability value

Discussion

The major findings of the current study highlighted that under water TTP resulted in significant increase in trunk lateral flexion ROM toward affected and significant decrease in trunk lateral flexion ROM toward unaffected with increase in trunk symmetry between both sides compared to over-ground TTP in survivors with Stroke. Indicate increased mobility, weight shifting ability on the affected limb and improvement on gait kinematics.

The results are consistent with the results of Pei-Hsin et al. [14] summarized that the water-based exercise, for stroke patients, showed more significant improvement in weight-shifting ability, dynamic balance, and functional mobility as compared with the land-based intervention. Moreover, Chae et al. [15] concluded that hydrotherapy exhibited significant effects on improving postural balance in chronic stroke patients than in sub-acute patients with stroke.

The water environment serves as a partial support for the body, allowing for mobilization of joints. Also, aquatic therapy provides motor and sensory stimuli that can potentially improve balance and muscle function [16]. Furthermore, the buoyancy of water might allow stroke patients to move with less effort and across movement planes that would be difficult during over-ground gait training without assistance [17].
The results are consistent with previous work of Leticia et al. [18] confirming that aquatic training in stroke patients significantly improves motor functions. These improvements can be attributed to the water environment, which partially supports the body, thus facilitating whole body movements.
Water is a fluid medium, with medium density and viscosity, which reduces the speed of movement, and because of this, when an individual enters a pool with water at waist level, approximately 50% of the weight is reduced, in addition to reducing gravity, in water, the probability of falling decreases by 21–23%. This means that people experience greater mobility in water with greater range of motion [19].
Post treatment results, showed no significant difference in trunk flexion in initial contact, trunk extension in mid-stance and terminal stance between groups post treatment ($p > 0.05$).
These results are in agreement with Byoung et al. [20] four weeks of aquatic trunk exercise showed that the Electromyography values for the patients' erector spine muscles tended to decrease at the end of the treatment period. Also there was no statistical difference between the patients' pre- and post-training values of maximal voluntary isometric contraction of the rectus abdominis, but the external abdominal oblique, transversus abdominis and internal-abdominal oblique values (which are activated during trunk rotation and would improve trunk functionality) tended to improve.
The result of the study in agreement with Mahdi et al. [21] evaluates effects of hydrotherapy on postural control and electromyography parameters in men with chronic non-specific low back pain. Electromyography activity of lumbar erector spinae muscles in both of sides didn't indicate a significant difference before and after intervention and a significant difference observed between two groups in balance index.
The results are consistent with the results of Masumoto et al. [22] compared the electromyography activity of the lower limb muscles during walking on land and in water and concluded that activity of the muscles is lower while walking and creating maximum voluntary contraction in the water compared with land. It is possible that both buoyancy and hydrostatic pressure of water may remove the pressure on the muscles and joints pain and prevent a significant change in the level of muscle activity, especially erector spinae muscles, after a period of hydrotherapy.

Limitations
The study was limited to men as a result of cultural constrain preventing women from uncover area of marker in public places. As well as, the analysis was limited to two planes and trunk motion analysis is three dimensional; thus the finding provide a partial picture of trunk kinematics.

Conclusion
The results of this study concluded that underwater treadmill training program is more effective than over-ground treadmill training program on improving trunk stability and mobility during the gait cycle which has positive effects on gait kinematic of stroke patients.

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Piśmiennictwo/ References

1. Wissel J, Olver J and Sunnerhagen K S. 'Navigating the post stroke continuum of care', Journal of Stroke and Cerebrovascular Diseases: The Official Journal of National Stroke Association. Jan 01, 2013, 22 (1), 1-8.
2. Mukherjee D and Patil C G. 'Epidemiology and the global burden of stroke', World Neurosurgery. 2011 Dec; 76 (6 Suppl), S85-S90.
3. Louis N Awad, Jaehyun Bae, Kathleen O'Donnell, et al. A soft robotic exosuit improves walking in patients after stroke. Research article neuro-rehabilitation. Science Translational Medicine. 26 Jul 2017; Vol. 9, Issue 400, eaai9084.
4. Ryerson S, Byl N N, Brown D A, et al. Altered trunk position sense and its relation to balance functions in people post-stroke', Journal of Neurologic Physical Therapy, 2008, 32 (1), 14-20.
5. Mi Eun Lee, Geun Yeol Jo, Hwan Kwon Do, et al. Efficacy of Aquatic Treadmill Training on Gait Symmetry and Balance in Subacute Stroke Patients. Ann Rehabil Med. V. 41(3); 2017 Jun.
6. Dong-Jin Lee and Sung-Hyoun Cho. Effect of aquatic exercise on gait in persons with chronic stroke: a meta-analysis study in Korea. Physical Therapy Rehabilitation Science 2019; 8:112-23.
7. Pei-Hsin Ku, Szu-Fu Chen, Yea-Ru Yang, et al. The effects of Ai Chi for balance in individuals with chronic stroke: a randomized controlled trial. Sci Rep. 2020; 10: 1201.
8. Jung T, Kim Y, Lim H and Vrongistinos K. The influence of water depth on kinematic and spatiotemporal gait parameters during aquatic treadmill walking. Sports Biomech. 2018 January;18 (3):1-11.
9. Zhizhong Zhu, Liling Cui, Miaomiao Yin, et al. Hydrotherapy vs. conventional land-based exercise for improving walking and balance after stroke: A randomized controlled trial. Clinical rehabilitation. 2016; Vol. 30(6) 587–593.
10. Brad Manor, Wanting Yu MEng, Hao Zhu, et al. Smartphone App–Based Assessment of Gait During Normal and Dual-Task Walking: Demonstration of Validity and Reliability. JMIR Mhealth Uhealth. 2018 Jan 30; 6(1):e36.
11. Andrea Baraldi Cunha, Iryna Babik, Regina Harbourne, et al. Assessing the Validity and Reliability of a New Video Goniometer App for Measuring Joint Angles in Adults and Children. Archives of Physical Medicine and Rehabilitation. Arch Phys Med Rehabil. 2020 Feb;101(2): 275-282.
12. Robert MC. "Significance level". In Salkind, Neil J. Encyclopedia of Measurement and Statistics. 3 Thousand Oaks, CA: SAGE Publications. 2007; pp. 889–891. ISBN 1- 412-91611-9.
13. Asharani N and Umarani K. Acoustic Analysis of Nasal and Oral Speech of Normal versus Cleft Lip and Palate. IJSRD - International Journal for Scientific Research & Development. Vol. 3, Issue 05, 2015. ISSN (online): 2321-0613.
14. Pei-Hsin Ku, Szu-Fu Chen, Yea-Ru Yang, et al. The effects of Ai Chi for balance in individuals with chronic stroke: a randomized controlled trial. Sci Rep. 2020; 10: 1201.
15. Chae Choong Sik, Jun Ji Hyun, Im Sun, et al. Effectiveness of Hydrotherapy on Balance and Paretic Knee Strength in Patients with Stroke. A systematic Review and Meta-Analysis of Randomized Controlled Trials. American Journal of Physical Medicine & Rehabilitation: May 2020 - Volume 99 - Issue 5 - p 409-419
16. Katarzyna Bulińska, Łukasz Rogowski, Tomasz Gołębiowski, et al. The effects of aquatic exercises on physical fitness and muscle function in dialysis patients. Biomed Res Int, 2015: 912980.
17. Suomi R and Koceja DM. Postural sway characteristics in women with lower extremity arthritis before and after an aquatic exercise intervention. Arch Phys Med Rehabil 2000; 81: 780–85.
18. Leticia C C, Stella M M, Helio R, et al. Vertical reaction forces and kinematics of backward walking underwater. Gait & Posture. Volume 35, Issue 2, February 2012, Pages 225-230.
19. Florian Tripp and Karsten Krakow. Effects of an aquatic therapy approach (Halliwick-Therapy) on functional mobility in subacute stroke patients: A randomized controlled trial. Clin. Rehabil. 2014, 28, 432–439.
20. Byoung Sun Park, Ji Woong Noh, Mee Young Kim, et al. The effects of aquatic trunk exercise on gait and muscle activity in stroke patients: a randomized controlled pilot study. J Phys Ther Sci. 2015 Nov; 27(11): 3549–3553.
21. Mahdi Mahjur, Seyed Ali Javaheri, Hossein Soltani and Nahid KHoshraftar Yazdi. Effects of Hydrotherapy on postural control and electromyography parameters in men with chronic non-specific low back pain. ISSN No: 2319-5886 International Journal of Medical Research & Health Sciences, 2016, 5, 5:153-157.
22. Masumoto Kenji, Mercer John A Mercer. Biomechanics of human locomotion in water: an electomyographic analysis. Exercise and sport sciences reviews. 2008; 36 (3):160-9.