

Meta-Analysis the Effect of Hydrotherapy on the Elevation of Motoric Functional Ability in Post Stroke Patients

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ABSTRACT

Background: Stroke is the third leading cause of death in the world after heart and cancer and the disease that causes serious and permanent disability is the first in the world. Hydrotherapy in stroke plays a role in developing, maintaining, and restoring movement and function with motor training based on an understanding of the pathophysiology, neurophysiology, kinematics and kinetics of normal motion. The purpose of this study was to analyze the effect of hydrotherapy on improving motor functional ability in post-stroke patients.

Subjects and Method: This study was a meta-analysis with the following PICO, population: stroke patients. Intervention: administration of hydrotherapy. Comparison: Standard therapy. Result: motor functional improvement. The articles used in this study were obtained from three databases, namely Google Scholar, Pubmed, and Science Direct. Keywords to search for articles “hydrotherapy” OR “Aquatic therapy” AND “functional enhancement” AND “post stroke”. The articles included are full-text English with a randomized control trial study design from 2002 to 2022. Article selection was carried out using PRISMA flow diagrams. Articles were analyzed using the Review Manager 5.3 application.

Results: A meta-analysis of 9 studies from China, Korea, Italy, Spain and Brazil concluded that hydrotherapy has an effect on post-stroke functional improvement. Post-stroke patients who received hydrotherapy intervention had motor functional ability 0.68 units higher than those who did not receive hydrotherapy. The difference was significant (SMD= 0.68; 95% CI = 0.44 to 0.91; p=0.001).

Conclusion: Hydrotherapy improves motor functional ability of post-stroke patients.

Keywords: Hydrotherapy, functional enhancement, post stroke

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Cite this as:

Wibisono LS, Prasetya H, Murti B (2022). Meta-Analysis the Effect of Hydrotherapy on the Elevation of Motoric Functional Ability in Post Stroke Patients. *Indones J Med.* 07(01): 73-81. <https://doi.org/10.26911/theijmed.2022.07.01.08>.



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BACKGROUND

Stroke is a disease that is the third leading cause of death in the world after heart and cancer. Stroke is also a disease that causes serious and permanent disability in the first order in the world. In the world, stroke occurs in more than 15 million people every year. Of these 15 million people, 5 million

died, and others survived, but experienced permanent disabilities and lived dependent on their families and communities, and a small number of people recovered as before they had a stroke (WHO, 2010).

In Indonesia, according to Riskedas data in 2013, there was an increase in the number of stroke sufferers, from 8.3 per

mile in 2007 to 12.1 per mile in 2013. Meanwhile, the results of Riskedas 2018 show that the prevalence of non-communicable diseases has increased compared to Riskedas 2013, in 2013. Among the prevalence of non-communicable diseases that experienced an increase was the prevalence of stroke rose from 7 percent to 10.9 percent.

Decreased functional ability can make stroke sufferers unproductive, in carrying out daily activities they must get help from others, so a recovery program is needed that aims to improve the functional abilities of post-stroke patients so that they can perform daily activities independently.

Stroke is a disease that is the third leading cause of death in the world after heart and cancer. Stroke is also a disease that causes serious and permanent disability in the first order in the world. In the world, stroke occurs in more than 15 million people every year. Of these 15 million people, 5 million died, and others survived, but experienced permanent disabilities and lived dependent on their families and communities, and a small number of people recovered as before they had a stroke (WHO, 2010).

In Indonesia, according to Riskedas data in 2013, there was an increase in the number of stroke sufferers, from 8.3 per mile in 2007 to 12.1 per mile in 2013. While the results of Riskedas 2018 show that the prevalence of non-communicable diseases has increased compared to Riskedas 2013, among the prevalence of non-communicable diseases that have increased is the prevalence of stroke rose from 7 percent to 10.9 percent.

Decreased functional ability can make stroke sufferers unproductive, in carrying out daily activities they must get help from others, so a recovery program is needed that aims to improve the functional abilities of post-stroke patients so that they can carry out daily activities independently.

Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 65 of 2015 concerning Physiotherapy Service Standards, physiotherapy is a form of health service aimed at individuals and/ or groups to develop, maintain and restore body movement and functions throughout the life span by using manual handling, motion improvement, equipment (physical, electro-therapeutic and mechanical), function training, and communication. According to Irfan (2012), physiotherapy in stroke plays a role in developing, maintaining, and restoring motion and function with motor training based on an understanding of the pathophysiology, neurophysiology, kinematics and kinetics of normal motion. One of the modalities of physiotherapy with water media is through hydrotherapy.

Hydrotherapy uses the principles of water, known as hydrodynamics, to cause physiological changes. These principles are buoyancy, density, viscosity, thermodynamics, and hydrostatic pressure that act together to provide the patient with a unique sensory experience to facilitate range of motion (ROM), functional strength, and balance (Aquatic, 2016). In addition, it can also improve the quality of life of patients with the recreational and relaxation effects of exercise activities in hydrotherapy. The purpose of this study was to analyze the effect of hydrotherapy on the improvement of motor functional abilities in post-stroke patients.

SUBJECTS AND METHOD

1. Study Design

This research is a systematic research and meta-analysis. The articles used in this study were obtained from several databases, namely Google Scholar, Pubmed, and Science Direct between 2002 and 2021. Article selection is carried out using prisma flowcharts. The keywords to search for the article are as

follows "Hydrotherapy" OR "Aquatic therapy" AND "functional enhancement".

2. Inclusion Criteria

The inclusion criteria in this research article were: full-text article with randomized control trial design, study subjects were post-stroke patients, study results were pain relief, multivariate analysis with Standardized mean difference (Mean – SD) to measure the predicted effect..

3. Exclusion Criteria

The exclusion criteria in this research article were: articles published in languages other than English, statistical results reported in the form of bivariate analysis, articles before 2002.

4. Operational Definition of Variable

The search for articles was carried out by considering the eligibility criteria determined using the PICO model. Population: stroke patients. Intervention: administration of hydrotherapy. Comparison: standard therapy. Result: motor functional improvement.

Hydrotherapy, also known as pool therapy or aquatic physical therapy, is a form of rehabilitation to improve function, endurance, balance, coordination, strength, and flexibility.

Motor functional ability is a person's ability to carry out specific activities related to the routines of daily life that are integrated in the activity environment.

5. Study Instrument

The study was guided by the PRISMA flow chart and quality assessment using Crical Appraisal.

6. Data analysis

The data in the study were analyzed using the Review Manager application (RevMan 5.3). Forest plots and funnel plots were used to determine the size of the relationship and heterogeneity of the data. The fixed effects model is used for homogeneous data, while the random effects model is used for heterogeneous data across studies.

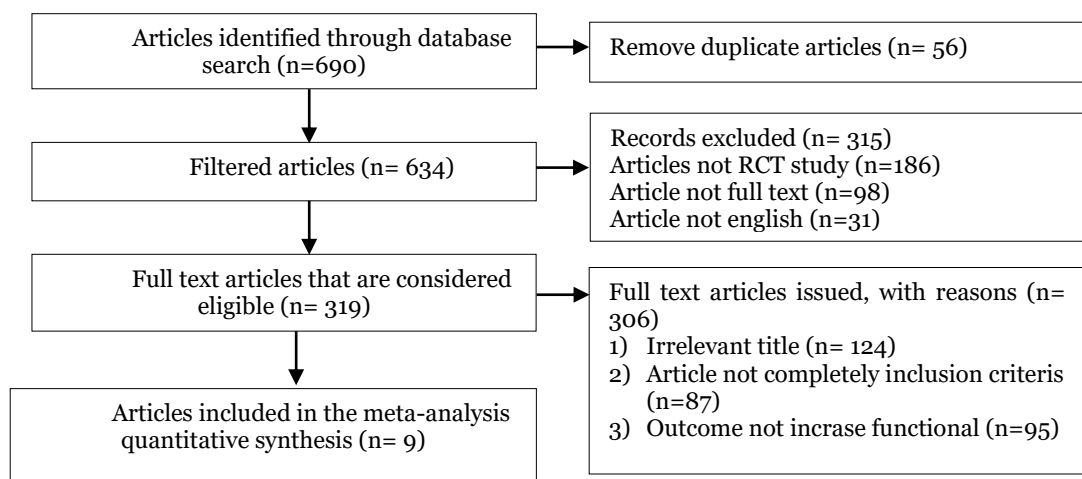


Figure 1. PRISMA flowchart

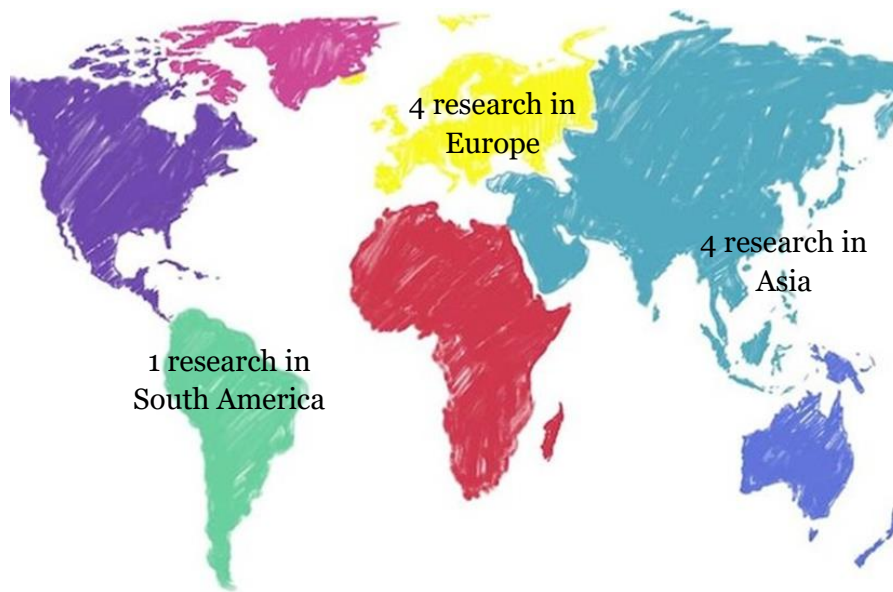


Figure 2. Map of the study area effect of hydrotherapy to functional enhancement

Table 1. Results of Quality Assessment of Randomized Control Trial Studies The Effect of Hydrotherapy on Increasing Functional Ability

Author (Tahun)	Criteria												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Tripp and Krakow (2014)	1	1	1	1	0	1	1	1	1	1	0	1	11
Temperoni et al. (2020)	1	1	1	1	0	1	1	1	1	1	0	1	11
Park et al. (2019)	1	1	1	1	1	1	1	1	1	1	0	1	12
Aidar et al. (2018)	1	1	0	1	1	1	1	1	1	1	1	1	11
Pérez-De la Cruz,(2020)	1	1	1	1	0	1	1	1	1	1	0	1	11
Park et al. (2015)	1	1	0	1	1	1	1	1	1	1	0	1	11
Zhang et al. (2016)	1	1	1	1	0	0	1	1	1	1	0	1	10
Zhu et al. (2016)	1	1	1	1	1	1	1	1	1	1	0	1	12
Eyvaz et al., (2018)	1	1	1	1	1	1	1	1	1	1	0	1	11

Note: 1=Yes, 0=No. In question item number 11, a score of 1 is given because the question has a positive score

Table 2. Description of the Primary Studies Included in the Meta-Analysis of Hydrotherapy on Increasing Functional Ability

Author (Year)	Country	Study Design	Sample	P Population	I Intervention	C Comparison	O Outcome
Tripp and Krakow (2014)	Germany	RCT	30	Adult patients after the first stroke who have been hospitalized for at least 2 weeks after the onset of stroke	Aquatic therapy Halliwick Therapy Program for 2 weeks	Conventional Therapy Program	Postural stability with Berg Balance Scale, Functional ability with Functional Ambulation Categories (FAC) and Rivermead Mobility Index
Temperoni et al. (2020)	Italy	RCT	24	Patients with chronic stroke (>6 months after stroke)	Sequential Preparatory Approach (SPA) based training program for 1 month	Conventional water therapy program	Improve exercise and functional ability with the Berg Balance Scale, the modified Barthel Index Tinetti balance and gait scale, the Stroke Specific Quality of Life Scale, and the modified Ashworth Scale
Park et al. (2019)	South Korea	RCT	29	Patients with chronic stroke (>6 months after stroke)	Land-based exercise program and Aquatic Trunk Exercise for 30 minutes per day, 5 days per week for 4 weeks	Conventional Therapy Program 30 minutes, 2 times per day, 5 days per week for 4 weeks	Functional Ability and balance with Trunk Impairment Scale (TIS), Berg Balance Scale (BBS), Functional Reach Test (FRT), The Modified Barthel Index (MBI)
Zhu et al. (2016)	China	RCT	28	Chronic stroke	hydrotherapy	Conventional therapy	Functional Reach test
Eyvaz et al., (2018)	Turki	RCT	60	Chronic stroke	hydrotherapy	Conventional therapy	FIM
Pérez-De la Cruz (2020)	Spanish	RCT	40	Patients with chronic stroke in Spain between February-September 2018	hydrotherapy for 12 weeks	Dry Land Therapy for 12 weeks	Pain evaluation with Visual Analogue Scale (VAS), balance and gait with Tinetti Balance and gait, single leg-stance, and 30 second stand test
Park et al. (2015)	South Korea	RCT	13	Chronic stroke	hydrotherapy for 4 weeks	Conventional therapy	EMG Evaluation
Zhang et al. (2016)	China	RCT	36	Chronic stroke	hydrotherapy	Conventional therapy	Bathel Indeks Index

RESULTS

The article search process is carried out through several journal databases, including Google Scholar, Pubmed, and Science Direct. The review process for related articles can be seen in the PRISMA flowchart in figure 1. Research related to hydrotherapy on improving functional ability consists of 9 articles from the initial search process yielding 690 articles, after the deletion process was published articles with 319 requirements for further full-text review. A total of 9 articles that met the quality assessment were included in the quantitative synthesis using a meta-analysis. It can be seen in Figure 2 that the research articles come from three continents, namely Europe, Asia and South America. Table 2, researchers conducted an assessment of the quality of the study using critical appraisal tools randomized controlled trial (RCT) published by CEBM University Of Oxford 2014:

- a. Does the research address clearly focused statements/problems?
- b. Is the Randomized Controlled Trial research method appropriate to answer the research question?
- c. Are there enough subjects in the study to establish that the findings did not occur by chance?
- d. Were subjects randomly allocated to the experimental and control groups? If not, could this be biased?
- e. Are inclusion/exclusion criteria used?
- f. Were the two groups comparable at the start of the study?
- g. Were objective and unbiased outcome criteria used?
- h. Are objective and validated measurement methods used in measuring the results? If not, were results judged by someone who did not know the group assignment (ie was the assessment blinded)?

- i. Is effect size practically relevant?
- j. How precise is the estimate of the effect? Is there a confidence interval?
- k. Could there be confounding factors that have not been taken into account?
- l. Can the results be applied to your research?

1. Forest Plot

A meta-analysis of 9 studies from China, Korea, Italy, Spain and Brazil concluded that hydrotherapy has an effect on post-stroke functional improvement. Post-stroke patients who received hydrotherapy intervention had motor functional ability 0.68 units higher than those who did not receive hydrotherapy. The difference was significant (SMD = 0.68; 95% CI = 0.44 to 0.91; p = 0.001) indicating that the 9 studies conducted meta-analysis resulted in estimates of the effect of hydrotherapy which were more or less similar (homogeneous) because they were homogeneous, so how to combine the estimated results of the 9 studies using the fixed effect model).

2. Funnel Plot

The funnel plot of Figure 4 indicates an unequal distribution of Effect estimates across 9 studies, particularly studies with small sample sizes. The funnel plots showed a distribution of estimated hydrotherapy effects that was more to the left of the mean (0% Fe < SMD < 0.68 CI 95% = 0.44 to 0.91; p=0.001). The plot on the right of the graph appears to have a standard error (SE) between 0.2 and 0.5. The plot on the left of the graph appears to have a standard error (SE) between 0.3 and 0.4, indicating publication bias. This publication bias contradicts the overall effect estimate of the 9 studies. This indicates a tendency to underestimate the effect.

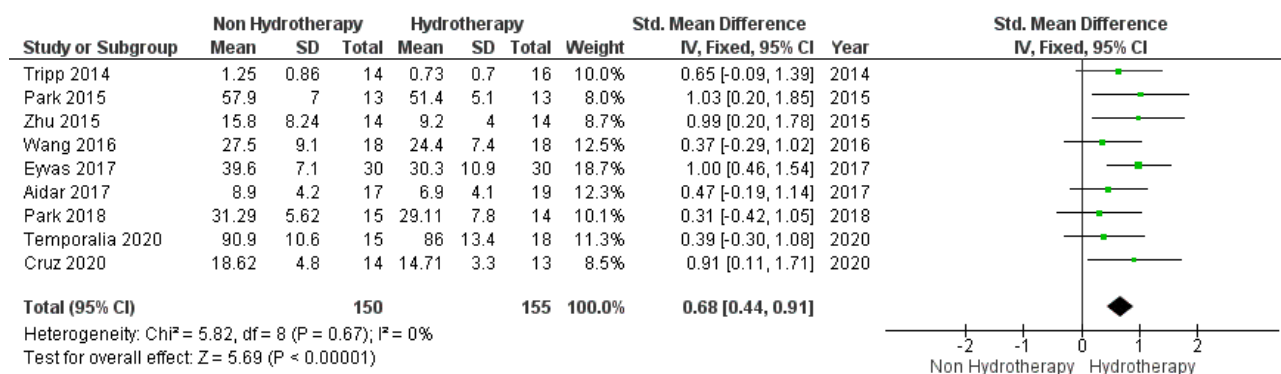


Figure 3. Forest Plot Effect of Hydrotherapy on Increasing Functional Ability

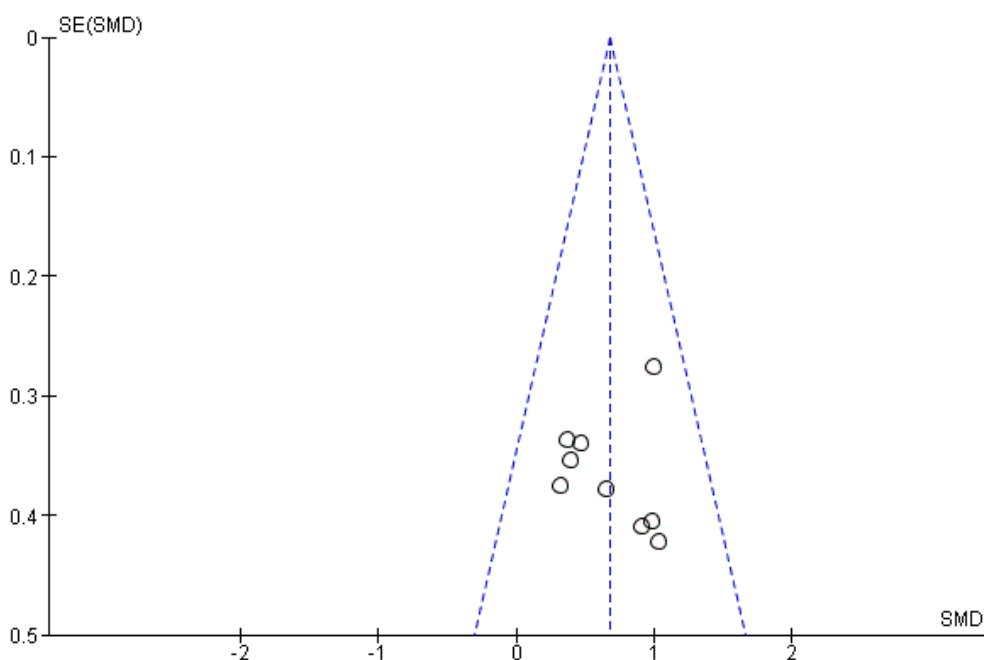


Figure 4. Funnel Plot Effect of Hydrotherapy on Improving Functional Ability

DISCUSSION

This research is a systematic research and meta-analysis with the theme of the effect of hydrotherapy on improving functional ability. This systematic study and meta-analysis used controlled research for confounding factors that could be seen from the inclusion requirements of the study, namely multivariate analysis, and statistical results reported by Standardized Mean Difference (Mean – SD). Estimates of hydrotherapy on increasing functional ability were processed using RevMan 5.3 with the generic inverse variance method.

The results of the systematic study and meta-analysis are presented in the form of forest plots and funnel plots. The forest plot provides an informational overview of each study examined in the meta-analysis, and an estimate of the overall outcome (Murthi, 2018). The funnel plot shows visually the amount of variation (heterogeneity) (Ako-beng, 2005 in Murthi, 2018). Funnel plots show the relationship between study effect sizes and the sample sizes of the various studies studied, which can be measured in a number of different ways.

The primary studies that met the criteria regarding the effect of hydrotherapy on improving functional ability were 9 articles from 4 European continents, 1 from South America, and 4 from Asia. This study concluded that stroke patients who received hydrotherapy intervention had 0.68 times success in improving functional ability compared to those who were not given hydrotherapy and the difference was statistically significant (SMD = 0.68; 95% CI = 0.44 to 0.91; $p < 0.001$). The heterogeneity of the research data shows $I^2 = 0\%$ so that the distribution of the data is declared homogeneous (fixed effect model).

Research conducted by Tripp et al., (2013) with the mechanism of fluid in water viscosity in hydrotherapy physiotherapy can improve functional ability in chronic stroke patients. This research is in line with Perez-De la Cruz (2020) one of the rehabilitation carried out to improve functional abilities is to do therapy in water with the characteristics of the exercise environment in water that can affect the physiological processes of motor, activity and flexibility and can provide psychological motivation for patients.

In the research of Zhang et al., (2018) Water as a unique training medium, facilitates easier functional movements, as a result of the buoyancy of water. In addition, water can provide somatosensory input resulting from hydrostatic pressure and temperature, which increases the information sent to the brain, sensory and motor information can basically improve motor functional abilities.

AUTHOR CONTRIBUTION

Lilik Sigit Wibisono is the main researcher who selects the topic, explores and collects data. Hanung Prasetya and Bhisma Murti played a role in analyzing data and reviewing research documents.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

FUNDING AND SPONSORSHIP

This research is self-funded.

ACKNOWLEDGMENT

We are very grateful to the database providers PubMed, Google Scholar and Science Direct.

REFERENCE

- Aidar FJ, Jacó De Oliveira R, Gama De Matos D, Chilibeck PD, De Soüza RF, Carneiro AL, Machado Reis V (2018). A randomized trial of the effects of an aquatic exercise program on depression, anxiety levels, and functional capacity of people who suffered an ischemic stroke. *J Sports Med Phys Fitness*. 58(7–8): 1171–1177. DOI: 10.23736/S00224707.17.07284-X.
- Aquatic A (2016). The Benefits of Aquatic Physical Therapy for Osteoarthritis for the Knee and Recovery after a Total Hip or Knee Arthroplasty. APTA Academy of Aquatic Physical Therapy.
- Eyvaz N, Dundar U, Yesil H (2018). Effects of water-based and land-based exercises on walking and balance functions of patients with hemiplegia. *Neuro Rehabilitation*. 43(2): 237–245. doi: 10.3233/NRE-182422.
- Irfan M (2012). *Fisioterapi Bagi Insan Stroke*. Yogyakarta. Graha Ilmu.
- Murti B (2018). *Prinsip dan Metode Riset Epidemiologi (5th ed.) (Principles and Research Methods of Epidemiology (5th ed.))* Program Studi Ilmu Kesehatan Masyarakat, Program Pascasarjana, Universitas Sebelas Maret
- Park BS, Noh JW, Kim MY, Lee LK, Yang SM, Lee WD, Shin YS, et al. (2015). The effects of aquatic trunk exercise on gait and muscle activity in stroke

- patients: A randomized controlled pilot study. *J Phys Ther Sci.* 27(11): 3549–3553. DOI: 10.1589/jpts.27.35-49.
- Park H, Lee J, Lee J, Lee W (2019). Land-based and aquatic trunk exercise program improve trunk control, balance and activities of daily living ability in stroke: A randomized clinical trial. *Eur J Phys Rehabil Med.* 55(6): 687–694. DOI: 10.23736/S1973-9087.18.-05369-8.
- Pérez-De la Cruz (2020). Comparison of aquatic therapy vs. dry land therapy to improve mobility of chronic stroke patients. *Int J Environ Res Public Health.* 17(13): 1–12. DOI: 10.3390/ijerph17134728.
- Rikesdas (2013). Riset Kesehatan Dasar. <http://www.depkes.go.id/resources/download/general/Hasil%20Rikesdas%202013.pdf>
- Riskesdas (2018). Hasil Utama Riskesdas (Main Results of Riskesdas). Kementerian Kesehatan Republik Indonesia
- Temperoni G, Curcio A, Iosa M, Mangiarotti M A, Morelli D, De Angelis S, Vergano S, et al. (2020). A water-based sequential preparatory approach vs. conventional aquatic training in stroke patients: A randomized controlled trial with a 1-month follow-up. *Frontiers in Neurology,* 11: 1–7. DOI: 10.3389/fneur.2020.00466.
- Tripp F, Krakow K (2014). Effects of an aquatic therapy approach (Halliwick-Therapy) on functional mobility in subacute stroke patients: A randomized controlled trial. *Clin Rehabil.* 28(5): 432–439. DOI: 10.1177/02692-15513504942
- World Health Organization (WHO) (2014). Stroke, Cerebrovascular Accident. Retrieved October 1, 2021, from http://www.who.int/topics/cerebrovascular_accident/en/.
- Zhang Y, Wang YZ, Huang LP, Bai B, Zhou S, Yin MM, Zhao H, Zhou XN, Wang HT (2016). Aquatic Therapy Improves Outcomes for subacute stroke patients by enhancing muscular strength of paretic lower limbs without increasing spasticity: A randomized controlled trial. *Am J Phys Med Rehabil.* 95(11): 840–849. DOI: 10.1097/PHM.0000-000000000512.
- Zhu Z, Cui L, Yin M, Yu Y, Zhou X, Wang H, Yan H (2016). Hydrotherapy vs. conventional land-based exercise for improving walking and balance after stroke: A randomized controlled trial. *Clin Rehabil.* 30(6): 587–593. DOI: 10.1177/0269215515593392.