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The Role of Hydrotherapy in Stroke Patient Rehabilitation -  
Clients' Own Experience

Degree Programme in Physiotherapy  
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# THE ROLE OF HYDROTHERAPY IN STROKE PATIENT REHABILITATION – CLIENTS' OWN EXPERIENCE

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## Abstract:

The purpose of this thesis was to gather theory about hydrotherapy and its role in stroke patient rehabilitation and gathering information through interviewing clients on their views and experiences with hydrotherapy as being a part of their rehabilitation process post stroke. This topic was researched to get a deeper picture of hydrotherapy and its importance in being a part of a rehabilitation plan.

The theoretical part of this thesis talks about hydrotherapy: its history, physiological and therapeutic effects of water and its importance. Thesis also includes theory on stroke: its risk factors, classification and diagnosis. This thesis answers questions on how hydrotherapy has an influence on physical strength, movement in joints, and overall well-being post stroke.

For the practical part of the thesis, an interview was conducted for clients who currently have hydrotherapy as a part of their rehabilitation process and get a glimpse of their own experiences. Quantitative data for this study was conducted through an interview interviewed by the author. It was shown that comparing the theory and the client's own experience, there were similarities between them. After analyzing the interview answers, there were improvements in muscle strength, improvements in joint movement and increase in self-confidence.

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## 1 INTRODUCTION

Stroke presents a major global public health challenge. Together with ischaemic heart disease, stroke is the largest source of disease burden. To address the problem, many people join a multidisciplinary rehabilitation program soon after having a stroke. There are many different rehabilitation approaches to improve disability after stroke. One example is hydrotherapy. Hydrotherapy has many different wordings such as aquatic therapy and sometimes water-based exercise. These are defined according to Hydrotherapy Association of Chartered Physiotherapy Guidance on Good Practice in Hydrotherapy as a therapy program using the properties of water, designed by a suitable qualified physiotherapist, to improve function, ideally in a purpose-built and suitably heated hydrotherapy pool. (Mehrholz, Kugler, Pohl 2011, HAPC 2006, 2)

This thesis was written because there is an extensive research base supporting hydrotherapy, both within the basic science literature and clinical literature (Becker 2009, 859). This topic is important if the physiotherapist has an interest in working with patients in an aquatic environment. This thesis consists of theory about hydrotherapy and its therapeutic and physiological effects of water, physiotherapist's role in hydrotherapy and lastly a interview that speaks about participants own experience of hydrotherapy.

Throughout this journey, the author has received a lot of help and would like to thank ever person who has had a big impact in filling the parts of this thesis. A big thank you to her supervisor for taking the time to listen to all the ideas that were put on the table, guiding the author every step of the way to finishing, and supporting the author throughout the entire process. The author would also like to thank her practice placement physiotherapy tutor who took the time to search and promote my work for possible participants for the practical part of this thesis. Finally, a big thank you to all the participants who took the time to tell their story and experiences that has had a positive impact in their lives.

## 2 AIMS AND OBJECTIVES

The aim for this thesis is to emphasize the use and role of hydrotherapy in stroke rehabilitation.

The objectives for this thesis was to interview participants who have hydrotherapy as part of their rehabilitation and ask about their own experiences in hydrotherapy. The interview consists of questions that ask about their experience in hydrotherapy, and how the therapy has affected their lives post stroke. The author was mostly interested in the client's own experience and if there has been any progress that has happened for example their range of motion, muscle strength, etc.

## 3 PHYSIOLOGICAL EFFECTS OF WATER

Water can provide an alternative way for patients to do exercises that cannot be done on land. There is a possibility of considerable perceptual stimulation through visual, aural, and through the skin proprioceptors and by heat (Campion 1997, 3). It is important to know and understand the fundamental principles of water such as density, drag, buoyancy, hydrostatic pressure and thermodynamics that relate to the therapeutic benefits of hydrotherapy in order to make the most effective rehabilitation plan. (Becker 2009, 860, Ellapen, T.J., Hammill, H.V., Swanepoel, M. & Strydom, G.L 2017, 2).

### 3.1 Relative Density

Relative density of water is taken as a ratio of one. Ratios of the human body differ with ages. Young children have a ratio of 0,86 while adolescent and early adulthood's relative density increases to 0,97. Later in life the body returns to a relative density of 0,87. Each part of the body has its own relative densities. The upper extremity is usually less dense than the lower extremity. Parts that are less dense float and denser parts sink. It is important to observe the density of the patient while assessing the patient.

While the patient is in the water, gravity and buoyancy are two opposing forces that act with relative density. Gravity goes in a downwards direction while buoyancy goes in an upwards direction. When gravity and buoyancy are equal, the body is balanced and has no movement. If gravity and buoyancy are unequal, movement occurs and there is rotation. For balance to occur, rotation occurs. (Campion 1997, 14-15).

The human body generally has a relative density of 0,97. If a person has a relative density that is less than one, the person will float. If the relative density of a person is greater than one, the person will sink. Lean body mass has a relative density that is greater than one while fat body mass is less than one. Patients with a lean body mass will sink while patients with a fat body mass will float. Whether the patient will sink or float, it is important to remember the safety of the patient. With minimal swimming skills, it is important to have an appropriate floating device. The floating device will assist the patient to stay afloat and will abstain from drowning. (Brody & Geigle 2009, 26)

### 3.2 Drag

In water, drag refers to the size of friction against movement. Drag increases when the patient increases force. With movement, magnitude of drag will neutralize and returns to zero, which provides hydro-resistance and prevent injuries similarly to land-based kinetics. (Ellapen, Hammill, Swanepoel, Strydom 2017, 2)

### 3.3 Buoyancy

Buoyancy provides the patient with weightlessness and joint unloading by decreasing force of gravity on the body. Buoyancy will change with the amount of air in the lungs. Lungs that are full of air buoyancy will increase and lungs with limited amount of air buoyancy will decrease. With buoyancy, the practitioner has a three-dimensional access to the patient. (Kisner & Colby 2012, 292) Buoyancy can assist, resist and support range of motion movement to help build strength and assist in gait training in the water. (Campion 1997, 14) With the help of buoyancy, the patient can do exercises without experiencing pain. (Becker 2009, 860)

Buoyancy occurs when a patient is in the water, decreasing the force of gravity on the joints. Buoyancy's allows patients to be more mobile in the water without the resistance of gravity. (Ellapen, Hammill, Swanepoel, Strydom, 2017, 2)

Archimedes buoyancy principle states: "when a body is fully or partially immersed in a fluid at rest, the body experiences an upward thrust equal to the weight of the fluid displaced". Buoyancy acting in the opposite direction of gravity, is related to the relative density of an immersed object. Patients who have a relative density less than 1 will have an upward thrust exerted on them that is greater than the weight of the fluid that they displace, causing them to float. (Brody, Geigle 2009, 26).

### 3.4 Hydrostatic Pressure

Hydrostatic pressure is defined by the pressure exerted by the water on immersed objects. As the density of the water and the depth of immersion increase, so does hydrostatic pressure. (Kisner & Colby 2012, 292-293) Hydrostatic pressure effects begin immediately when going into the water, causing plastic deformation of the body over a short period of time. Blood displaces towards the head, or the anterior end of the body, right arterial pressure and pleural surface pressure begins to rise, the chest wall compresses, and the diaphragm is displaced. (Becker 2009, 860)

Pascals Law states that the pressure exerted by fluid on an immersed object is equal on all surfaces of the object. The pressure is directly proportional to both the depth and the density of the fluid. (Bates & Hanson 1996, 27-28) Hydrostatic pressure helps stabilize unstable joints, reduce unnecessary swelling, gradually increases joint range of motion and combats spasticity. (Ellapen, Hammill, Swanepoel, Strydom 2017, 2)

### 3.5 Viscosity

Viscosity is the drag force of the water that provides resistance and impacts flow patterns and current. Water's viscosity creates resistance with all active movements and applying Bernoulli's Law results in improvement in muscle tone, postural awareness,

decreases edema and improves reaction time. Increasing the surface area moving through the water increases resistance. (Kisner & Colby 2012, 293, Gage & Pinkham 2013, 6)

### 3.6 Thermodynamics

Thermodynamics refers to the water's ability to transfer heat. (Ellapen, Hammill, Swanepoel, Strydom 2017, 2) Heat transfer starts when a patient goes into the water. As the heat capacity of the body is less than water, the body neutralizes faster than water does. (Becker 2009, 861)

Water temperature influences the body and on the performance in water. The body temperature of a client who is moving through the water will lose it faster than a patient who is standing still in the water. (Kisner & Colby 2012, 294) It is important to know the effects that temperature variation does to the body. Temperature variations will have an effect on joint stiffness, pain relief, muscle spasm, blood flow, etc. (Pinkham & Gage 2013, 6)

## 4 THERAPEUTIC EFFECTS OF WATER

The uniqueness in buoyancy is that it relieves stress on weight-bearing joints and permits movement to take place with reduced gravitational force, so non-weight-bearing activities can be done in water before they are done on land. The water provides the potential for exercise that cannot be done on land. Water gives the possibility for perceptual stimulation visually, aurally through skin proprioceptors and through heat. Therapeutic effects of water boost functional activities, improve blood circulation, relieve pain and muscle spasms, maintain and increase range of motion in joints, strengthen weak muscles, improve balance, coordination and posture, and educate



paralyzed muscles. The ability to be independent in the water gives a boost of confidence to the patient that can also be brought to other forms of therapy. (Campion 1997, 3-4)

The water is a medium that allows people to do exercises independently and safely. Water supports the whole-body during exercise more than during land-based exercise. Water helps to maintain body posture so that the patient does not have to rely on a certain body part while doing exercises. (Ellapen, Hammill, Swanepoel, Strydom. 2017, 2)

## 5 HYDROTHERAPY

Many different rehabilitation approaches have been used to help stroke survivors to walk independently with enough endurance and velocity. One type of intervention that is used to help this goal is hydrotherapy. Hydrodynamics provide environmental conditions that improve motor activities and physiological processes. (Zhizhuong, Liling, Miaomiao, Yang, Xiaona, Hongtu, Hua 2016, 588) The aquatic setting has rehabilitative potential, from treatment of acute injuries through health maintenance in the face of chronic disease, yet it remains an underused modality. (Becker 2009, 859) Hydrotherapy also known as aquatic therapy or water therapy, has been recognized as a therapeutic modality that is effective, yet underutilized. Hydrotherapy can be used just by itself or can be a part of a physiotherapy plan. (Kauranen 2017, 606-608)

Hydrotherapy is the use of water to facilitate healing and exercise and to enable patients to achieve therapy goals. In a pool a patient can be placed in non-weight-bearing positions such as supine, prone or sitting with the use of buoyancy devices. Water can serve as resistance to exercise to facilitate muscle strengthening. (Bukowski & Nolan 2016, 109)

Hydrotherapy enhances increased joint range of motion, aerobic capacity cardiorespiratory functioning and a reduced cardio metabolic risk, improved muscle strength and endurance, as well as decreased muscle fatigue and joint pain. The main areas that are

exercised are strengthening trunk muscles and improving balance. Hydrotherapy can be used in various temperatures. Ice baths that are often used by athletes post-training to reduce muscle soreness and dissipation of inflammation and to speed their recovery from training. (Ellapen, Hammill, Swanepoel, Strydom 2017, 1-2)

Public pool settings have a water temperature of 26°C-28°C. This would be good for high-intensity exercise. For low-intensity exercise it is good to have the water temperature at 30°C-34°C. Typical hydrotherapy pools range from 33,5°C-35,5°C. Warm water decreases muscle pain, lowers heart rate and enhances thermoregulatory responses, increases vasodilation and blood circulation. If the water temperature gets over 35°C, the body will start to experience tiredness. There are many types of water exercises methods including walking training, improving balance and coordination, water aerobics, water running, functional training, PNF based strength training and balance training. (Kauranen 2017, 606-608)

Aquatic therapy is less researched and has little evidence-based support in stroke recovery, especially in early stroke recovery. From the few research articles addressing aquatic therapy in stroke rehabilitation, most research articles address about chronic stroke survivor's levels. There is no literature or research that addresses the role of aquatic therapy in early stroke recovery as part of a comprehensive physical therapy plan of care, however, there is limited research that has been conducted that is promising to show statistical changes in balance in stroke survivors. (Pinkham & Gage 2013, 6)

## 5.1 History of Hydrotherapy

The history of hydrotherapy as a modality used in physical medicine goes back many thousands of years and a modality used for rehabilitation is as important today as it was in the past. The wording of hydrotherapy comes from the Greek words *hydro* (water) and *therapeia* (healing). The Greeks were among the first to appreciate the relationship between physical and mental well-being. At certain times hydrotherapy was first used as therapeutically is not known, however records dating back to 2400

BC suggest that proto-Indian culture made hygienic instillation, early Egyptians, Assyrians and Mohammedans used mineral waters for curative purposes. In 1500BC the Hindus used water to combat fevers. By 500BC the transition from mysticism and cult to a logical use of water for physical treatment had occurred. Baths were used for recreational activities, health and hygiene were pursued. Around 339 AD some of the baths were used for healing purposes and for the first symptoms of rheumatic disease, paralysis and post-injuries. Burns were treated in prolonged baths. John Wesley (1747), Dr. Wright (1779), and Sir John Floyer, (1967) were early pioneers of hydrotherapy. Sebastian Kniepp, Dr. Joel Shaw, Professor Winterwitz dedicated their lives to the scientific study to practice hydratics and gave a foundation to modern hydrotherapy. (Campion 1997, xi-xii)

Throughout history, this type of therapy has been called in many different words such as hydrotherapy, hydrology, water therapy, spa therapy, balneotherapy, water therapeutics and water exercise. Today, it is mostly referred to as aquatic therapy or aquatic rehabilitation. In the United States of America, hydrotherapy was developed as a treatment for neurological rehabilitation, in response to polio epidemic, and then for the amputees in World War I. Throughout the years, using water for therapy has spread through the world. Over time, new treatments were discovered, new names were discovered, and equipment was made, but overall aquatic principles have remained the same. Today, aquatic therapy is used to help improve balance, muscular endurance, muscular strength, motor skills, cardiovascular and pulmonary endurance, and pain management, range of motion, circulatory functions and help with weight bearing. (Howard 2016, 20)

Since the earliest recorded history, water has always been believed to promote healing and has therefore been widely used in the management of medical ailments. Through observation and centuries of trial and error, and scientific methodology, traditions of healing through aquatic treatments have evolved. Historically, the field of Physical Medicine viewed hydrotherapy as a central treatment methodology. (Becker 2009, 859)

## 5.2 Importance of Hydrotherapy in Stroke Rehabilitation

Many authors are of similar opinion that the benefits of hydrotherapy are the ability to enhancing aerobic capacity, improve muscle endurance and strength, increase joint range of motion, enhance cardiorespiratory functioning, reduce cardiometabolic risk profile as well as decrease joint pain and muscle fatigue and the qualities of the water environment can stimulate the sensory input and proprioception that can positively impact function in survivors after stroke. Hydrotherapy provides a different rehabilitation environment that gives upper and lower extremity muscle exercises and helps activate and sustain muscle activity, muscles responsible for initiating righting reactions are easily activated and the risk of falling is reduced. The warm water helps promote relaxation. (Pinkham & Gage 2013, 8, Ellapen, Gage, Hammill, Pinkham, Swanepoel, Strydom 2017, 1-2, 8)

## 6 STROKE

Stroke also known as cerebrovascular accident (CVA) that develops symptoms lasting 24 hours or longer or that can lead to death with no apparent cause other than of vascular origin. Stroke is the third most common cause of death worldwide and a major cause of disability. Standard age is 55 years or older. (Dewey 2006, Lennon & Stokes 2009, Stokes & Stack 2011, WHO 1988, 10, 51)

Stroke is considered 4<sup>th</sup> most common cause of death. In a year, about 25,000 (about 70 people per day) people in Finland have a stroke. Out of the 25,000 people, 16% experience transient cerebrovascular accidents, 59% experience a stroke, 10% experience a re-occurrence of a stroke, 5% subcutaneous haemorrhages. Today there are about 85,000 people who have experienced a stroke in Finland. The population is projected to grow as the population ages. After experiencing a stroke, 25% of people recover with no symptoms, 60% of people are independent, and 15% of people need inpatient care, 45% of people need rehabilitation in the acute stage and months after that. Every other person experience impairment, and out of those impairments, half are severe. 10-20% of stroke patients are left with dementia, and every third have aphasia,

25% of people die in a year post stroke. (Kauranen 2017, 344-345) It is important that rehabilitation is started right away for patients coming into the hospital. (Rissanen, Kallanranta, Suikkanen 2008, 257)

Stroke is a complicated condition having different causes and different effects on individuals. Loss of function may range from temporary to permanent or slight to devastating. Some functions may have an improvement, while some functions do not. Stroke compared to other medical condition causes more prolonged disability. Although strokes are much more common over 65 years of age, many people believe that strokes only happen to old folks. Strokes can occur at any age, including infancy, childhood, adolescence, and early adulthood. (Caplan 2008, 2-5)

Approximately 80% of stroke patients suffer motor impairments, which typically affects the control of movements of the arm, leg and face on one side of the body. Balance and gait deficits are commonly observed in this population, often leading to reduced ambulatory activity and limited mobility. (Zhizhuong, Liling, Miaomiao, Yang, Xiaona, Hongtu, Hua 2016, 588)

The recovery process after stroke is long and may take several years. The most recovery occurs within the first 6 months, up to the first 2 to 3 years, and is the most crucial. While some survivors may experience full recovery, at one-year post stroke two-thirds of all survivors will have disability. Six months after a stroke, more than 30% of survivors remain unable to walk independently. Physical therapy plans of care should address impairments and improve function. Common impairments that patients experience after stroke are hemiparesis, ataxia, hemiplegia, difficulty with left-right orientation, pain and decrease in joint mobility. These impairments can lead to decrease in functional mobility and increased fall risk. (Pinkham & Gage 2013, 6, Zhizhuong, Liling, Miaomiao, Yang, Xiaona, Hongtu, Hua 2016, 588)

## 6.1 Stroke Risk Factors

Some risk factors of stroke include age, being overweight, alcohol use, high cholesterol, high blood pressure, diabetes, transient ischaemic attack, smoking, for women diabetes during pregnancy and menopause. (Kauranen 2017, 344)

Hypertension is the most important risk factor for stroke, both men and women. In Finland and the United States, the observed changes among population levels in diastolic blood pressure, total cholesterol and smoking were followed by a decline in stroke incidence. (Stegmayr, Asplund, Kuulasmaa, Rajakangas, Thorvaldsen, Tuomilehto 1997)

## 6.2 Classification and Aetiology of Stroke

Strokes are classified into two main categories: ischaemic or haemorrhagic (Amarenco et al, 2009). An ischaemic stroke is caused by an interruption of the blood supply. A haemorrhagic stroke is caused by a ruptured blood vessel. Most strokes are ischaemic accidents (approximately 80%) In an ischaemic stroke, blood supply to a certain area of the brain is decreased, which causes dysfunction of the brain area supplied by the affected blood vessel. The main causes of ischaemic stroke are: thrombosis: obstruction of a blood vessel by a blood clot formed locally, embolism: obstruction of a blood vessel caused by blood clot (embolus) coming from somewhere else in the body, systemic hypoperfusion (e.g. when a person is in shock) or cerebral venous sinus thrombosis (caused by blood clot of the sinuses that drain blood from the brain). A haemorrhagic stroke can be an intracerebral or intracranial accident. An intracerebral haemorrhage is a stroke where blood is leaking directly into the brain tissue, building up a haematoma. An intracranial haemorrhage is the build-up of blood anywhere within the skull, typically somewhere between the skull and the meninges surrounding the brain and spinal cord. Haemorrhagic strokes are most common in small blood vessels and potential causes are hypertension, trauma, bleeding disorders, drug use and vascular malformation. (Stokes & Stack 2011, 10-11)

Table 6.1 below describes the key features of stroke. (Summarized from Baer & Durward 2004, with permission)

<b>Definitions</b>	<p><b>Stroke:</b> the sudden onset of a focal neurological deficit lasting more than 24 hours in which causes other than vascular have been excluded (WHO 2001).</p> <p><b>Hemiplegia:</b> the paralysis of muscles on one side of the body affecting the arm, trunk, face &amp; leg (contralateral to the side of the lesion in the brain)</p>
<b>Symptoms</b>	<p>Effects of stroke are determined by the areas of the brain damage, irrespective of the cause</p> <p><b>Left hemisphere lesion:</b> normally associated with severe communication problems</p> <p><b>Right hemisphere lesion:</b> normally associated with perceptual disturbances</p> <p><b>Common signs and symptoms are:</b> paralysis/paresis, dysphasia/aphasia (either a receptive or expressive problem affecting the understanding and use of correct words in speech or writing), dysarthria (problems of articulation in speech), dysphagia (problems with swallowing), hypertonia (increased muscle tone), hypotonia (reduced muscle tone), spasticity (velocity-dependent stretch reflex hyperactivity), hemianopia (visual field deficit), orofacial paresis (leads to problems with drooling swallowing &amp; feeding), fatigue, urinary incontinence, confusion/agitation, unilateral neglect, psychological problems (depression; emotional lability &amp; personal changes)</p>
<b>Time Course</b>	<p>The most rapid period of recovery occurs within the first 8-12 weeks: 40-50% residual recovery, 30% full recovery, 20% death within first 4 weeks, and 30% within the first year.</p>

(Lennon & Stokes. 2009, 53-54)

### 6.3 Diagnosis

Strokes are usually diagnosed by doing physical tests and studying images of the brain produced during a scan. Tests can be done to confirm the diagnosis and determine the cause of the stroke. Tests may include a blood test to find out your cholesterol and blood sugar level, checking your pulse for an irregular heartbeat. And taking blood pressure measurements. Even if the physical signs of a stroke are obvious, brain scans should also be done to determine if the stroke has been caused by a blocked artery or a burst blood vessel, which part of the brain has been affected and how severe the stroke is. (Website of NHS, 2019)

With the help of technology such as a computerized tomography scan or a magnetic resonance imaging scan and assessment, the diagnosis of stroke can be made. For ischaemic stroke, a magnetic resonance imaging scan is preferred. (Stokes & Stack 2011, Chalela 2007, 12)

#### 6.4 Acute Stage of Stroke

After entering the hospital, the patient is at rest for 24 hours or more if there has been a surgery and physiotherapy is started when the patients physical state is stable enough. Physiotherapy in the acute stage is combined with assessment of the current physical state, complications from bed rest. Physiotherapy may hinder on the patient's low level of consciousness, tiredness, problems with memory, extreme fatigue and visual impairments. (Kauranen, 2017, 349)

Primary goals of early rehabilitation are to prevent secondary emotional, intellectual and physical deterioration and to prepare the patient and relatives for the challenges ahead. The site and size of the stroke initially determines the degree of motor deficit which may range from slight incoordination to complete paralysis of the upper and lower limbs and face. (Carr & Shepherd 1999, 247-248)

### 7 ROLE OF PHYSIOTHERAPIST IN HYDROTHERAPY

There is a wide disparity of undergraduate training in hydrotherapy world-wide. In some countries there are recommended minimum hours that cover theory and practical work and placements of students with physiotherapists who have expertise and advocated (Campion 1997, 4). The knowledge of biological effects can help the clinician to create a treatment plan, with taking the appropriate aquatic activity, water temperature and treatment duration into consideration (Becker 2009, 859).



## 7.1 Training for Hydrotherapy

There are limited number of undergraduates in hydrotherapy training. The physiotherapist should know the subjects related to the mechanics of water and its physiological effects and therapeutic effects, theory and application on theory, movement in water, knowing how to assess a patient in the water, knowing safety and emergency procedures, and knowing maintenance and safety of the pool area. Without the knowledge of all listed above, the physiotherapist will not be able to give effective treatment and may produce tension, anxiety and adverse reaction in their patients. Staff should be trained in emergency action plan about the facility. Physiotherapists working in the pool should be trained in cardiopulmonary resuscitation, water safety and first aid. All equipment used in the therapy session should be maintained and cleaned and the water should be tested frequently if used on a daily or regular basis. Aquatic therapy should be used as indicated and individualized for each patient. (Bates & Hanson 1996, 8-9, Campion 1997, 4, Gage & Pinkham 2013, 29)

## 7.2 Hydrodynamic Principles

The physiotherapist needs to observe and analyze the shape of the person entering water for hydrotherapy and be able to instruct regarding the appropriate actions to be taken to counteract the rotational effects. It must be understood that these can occur in the vertical as well as the horizontal positions. (Campion 1997, 15)

## 7.3 Contraindications

Most patients can tolerate exercising in water. The practitioner must consider physiological and psychological aspects that affect when selecting a water environment. Fear of water can limit the effectiveness of exercising in water and the patient may experience a stress response, and muscle cramps. Patients usually need orientation time that provides instruction of the effects of being in the water on balance, the use of floating equipment, and control of the body while in water. Patients with ataxia may have trouble controlling purposeful movements, patients with heat intolerance may fatigue in

temperatures greater than 33°C, patients with respiratory disorders may have effects on their breathing. Patients with cardiac dysfunction with angina, blood pressure, heart disease or compromised pump mechanics need to be closely monitored. (Kisner & Colby 2012, 291) There are some contraindication that need to be considered are general infections, open wounds, tracheostomy, chlorine allergy, stoma, skin infections, rashes, uncontrolled hypertension, severe or uncompensated heart disease, seizures, fear of water, bladder and bowel dysfunctions etc. (Kauranen 2017, 603)

#### 7.4 Pools

Pools for hydrotherapy vary in size and shape. The rooms in which the pools are housed need to be adequately ventilated to avoid the accumulation of condensation on walls, windows, and floors. A dressing room should be provided for changing clothes and showering. Traditional therapeutic pools as shown in picture 1 measure at least 100 feet in length and 25 feet in width. Depth usually begins at 3 to 4 feet with a sloping bottom, progressing to 9 or 10 feet. This larger type of pool may be used for groups of patients and the therapist conducting the session while in the pool. These pools have built-in chlorination and filtration systems. Individual patient pools as shown in picture 2 are designed for individual patient use and are usually smaller, self-contained units. These self-contained pools are entered via a door or one to two steps on the side of the unit. The therapist provides instructions or cueing from outside the unit. In addition to built-in filtration systems, these units may include treadmills, adjustable currents and varying water depths. (Colby & Kisner 2009, 295-296)



Picture 1. Traditional Patient Pool. (Website of Pools by Design)



Picture 2. Individual Patient pool (Kisner & Colby 2012, 296)

## 7.5 Equipment

There are different kind of equipment that should be taken care of before starting any aquatic exercise with a patient. There is safety equipment, therapeutic equipment and exercise equipment.

When deciding on the right equipment to be used during the session, the physiotherapist needs to assess the patient's current functional level and know the specific goals for the therapy session. A large variety of different equipment exists. Some equipment is used to help the patient float, challenge or assist balance, and help to resist movement. Some examples of equipment include resistive paddles, floats, weighted stools

and chairs, paddle boards, etc. To increase intensity, the physiotherapist can add or remove equipment. (Kisner & Colby 2012, 296)

One of the most important equipment that a physiotherapist should have are safety equipment. Pictures 3 and 4 show safety equipment. Safety equipment such as picture 3 a first aid kit and picture 4 a pool safety rings should be easily accessible and visible. Safety equipment such as waterproof bandages, earplugs, nose plugs and standard items should be in a first aid kit. If a therapy class has multiple patients, there should be a lifeguard or another physiotherapist present in the pool area. (Bates & Hanson 1996, 29)



Picture 3. First Aid Kit (Website of Canadian Maintenance & Safety)



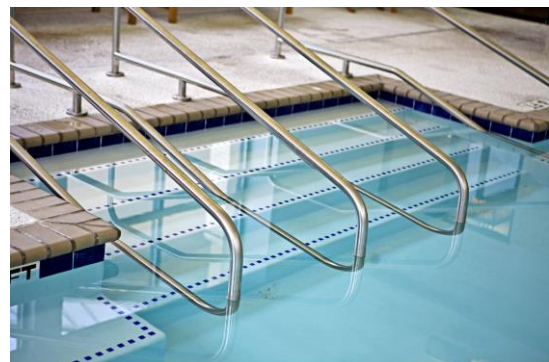
Picture 4. Pool Safety Ring (Website of Olympiad Sports & More)

Therapeutic equipment that are found in the pool area are lifts, parallel bars, aquatic stools, handrails or bars, wheelchairs and stretchers to name a few. Pictures 5, 6, 7 and 8 are examples of therapeutic equipment. Pictures 5 and 6 show lifts and steps that can

be fixed or moveable assist the patient to enter the pool. Steps that lead into the pool should be wide and have handrails on either side. Should be on both sides for safety reasons. The edge of each step should be marked with a contrasting color and have gripping. Gripping will minimize the risk of slipping and help the patient safely enter the water. Picture 7 shows handrails that can be fixed or moveable. The benefits of handrails are that they allow the patient to move around for freely and can perform exercises independently. The benefits of weighted stools are that they allow stability during upper extremity exercises performed while seated. Parallel bars are long stainless-steel bars that are on the side of the pool. These can also be fixed or moveable. These are used for safety and comfort during non-weight-bearing or partial weight-bearing exercises. Picture 8 shows a wheelchair that can be used in a shower for those patients that don't have enough strength to stand while in the shower. The wheelchair can also be used when bringing a patient into the pool area and out of the pool area. (Bates & Hanson 1996, 29-30)



Picture 5. Lift (Website of AmeriGlide)



Picture 6. Steps (Website of Lavaca Medical Center)



Picture 7. Handrails (Website of USA Quatics)



Picture 8. Wheelchair (Website of Active N Able)

When the patient is supine, equipment such as collars, rings, belts and vests are designed help the patient float. Pictures 9, 10 and 11 show flotation equipment. Collars are used to support the head when the patient is supine so that excess water will not get into their ears. Picture 9 shows a collar that is used to support the head. Flotation rings as shown in picture 10 are also used for patients who are in the supine position and help support the extremities that are immersed in the water during manual techniques for positioning and relaxation. Flotation rings as shown in picture 11 also come in various sizes and are usually found on the wrists and ankles. Belts are also used to help the patient float. There are several types of belts that can be used on a certain area of the body or the entire body. Belts are used to place the patient in a supine, prone or vertical position in shallow or deep-water activities. (Kisner & Colby 2012, 296)



Picture 9. Collar (Kisner & Colby 2012, 296)



Picture 10. Rings (Kisner & Colby 2012, 296)



Picture 11. Belts (Kisner & Colby 2012, 296)

Equipment such as swim bars and buoyancy dumbbells are available short or long. Swimming bars as shown in pictures 12 and buoyancy dumbbells as shown in picture 13 support the upper extremity when the patient is in an upright position and support lower extremities while in supine or prone position. These can be used to exercise balance. Proprioception and improve trunk strength. (Kisner & Colby 2012, 297)



Picture 12. Swim bars (Kisner & Colby 2012, 297)



Picture 13. Buoyancy dumbbells (Kisner & Colby 2012, 297)

Wrist and ankle weight are resistive equipment are seen used in water or on land. Wrist and ankle weights as shown in picture 14 provides resistance and stability in exercise in various range of motion. These also come in various sizes and colors. These have Velcro straps that are secured to the wrist and ankle. (Bates & Hanson 1996, 32)



Picture 14. Wrist and ankle weights (Website of Kiefer)

Some other equipment that can be used are stepping stool and stairs. Stepping stools can be placed on the bottom of the pool. The purpose of the stepping stool is that it is used to step on repeatedly. This can be used to practice stair walking. This can also be used for shorter patients to stand upright while doing upper body exercises or it can be used as an assistive device for stretching the lower body. Stairs that lead into the pool can also be used to practice stair walking or stepping. (Bates & Hanson 1996, 32)

#### 7.6 Pool Care and Safety

Safety rules and regulations and emergency procedures are very important. Safety procedures should be given to all that are using the pool. Life preserves should be available in case of an emergency. At least one staff member should be CPR certified. To avoid possible infections, pools must be cleaned regularly. If the pool is frequently used, the pools organic carbon will increase, and ammonia and organic nitrogen will be found in the pool. Cleaning the pool should be done twice a week and tests for chlorine and pH levels should as well be done twice a week. All walking surfaces should be slip-resistant and free of barriers. (Kisner & Colby 2012, 298)

## 8 THESIS PROCESS

This thesis process started with a meeting with Mari Törne for the discussion of possible ideas for the thesis. It was decided together to write about hydrotherapy and having an interview with participants who have hydrotherapy as a part of their rehabilitation process. A study plan was created and presented to the author's peers and teachers. When the study plan was accepted, the author proceeded to research theory and plan interview questions for the participants. The interview questions were decided based on the participants own experience.



Table 2. Timeline of the thesis process

Work phases	Timeline
Deciding topic of the thesis	September 2018
Reading and writing theory	November – December 2018
Presenting thesis plan	December 2018
Continuation of theory research	January – March 2019
Interviewing participants	April 2019
Gathering and analyzing results from interview	April 2019
Writing the rest of the theory	September 2019 – November 2019
Presenting thesis	November 2019
Maturity Exam	November 2019

The questionnaire was designed to get a better insight of how hydrotherapy has helped patients who have had a stroke and have been left with some impairments that have to be strengthened and rehabilitated. After searching through theory, the author wanted to see if there were any similarities between the theory and answers. The author wanted to see if there were any significant changes such as in muscle strength, improvement in joint movement, improvement in self-confidence, etc.

## 9 INTERVIEW

An interview was conducted for patients who currently have hydrotherapy as part of their rehabilitation process. The author has written down the participants answers onto a questionnaire. After each answer, the author checked that every word that the participants answered was written down. Each interview lasted for 45 minutes and after the author was able to watch their 45-minute hydrotherapy session with their physiotherapist.

The interview consisted of questions that asked about their own experience in hydrotherapy and how the therapy has affected their lives post stroke. For each interview the

author asked the questions in the same order. Quantitative data was gathered through the interview. The author interviewed 3 participants for this thesis.

## 10 RESULTS

Based on the questionnaire results, each participant felt that hydrotherapy has been one of the best rehabilitation methods in their rehabilitation processes. Each participant has had an improvement in their self-confidence, increase in muscle strength, increase in joint range of motion and slowly being able to participate in their activities of daily living.

All 3 participants have had hydrotherapy for 2 years. Two out of the three participants have received hydrotherapy from KELA, and one pays for the hydrotherapy sessions themselves.

### **Figure 1. What is hydrotherapy to you?**

As shown in figure 1, each participant gave their own view and meaning of hydrotherapy. Two participants viewed hydrotherapy as the time to get to move independently, one participant viewed hydrotherapy as a time of relaxation. One viewed that hydrotherapy helps them to experience less pain.



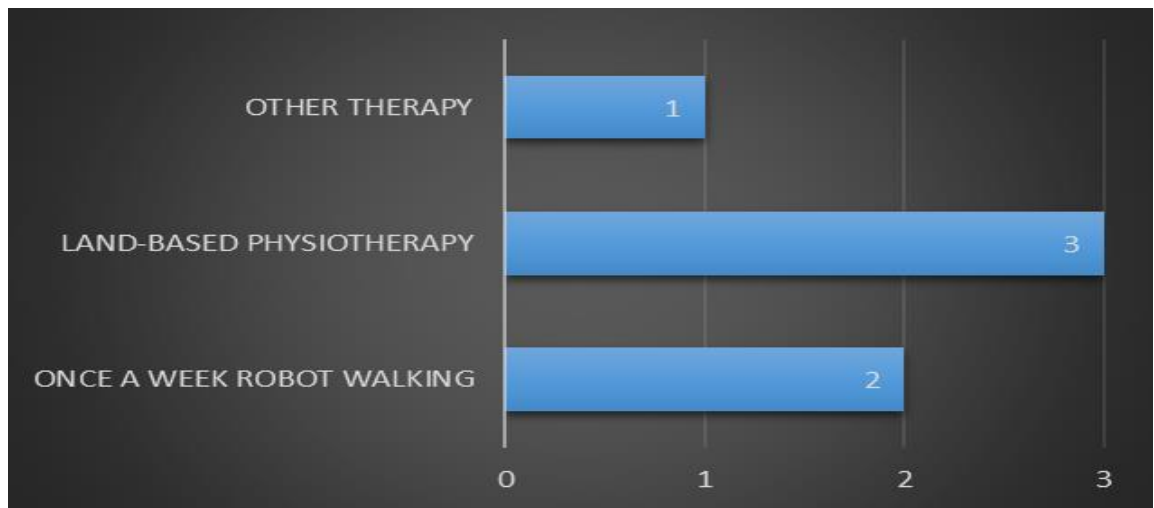
**Figure 2. Differences and or changes in symptoms**

As shown in figure 2, all 3 participants have experienced an increase in functional ability and to be able to do movements independently without assistance. One participant explained that with the increase in muscle strength, at home they can stand up with the assistance of an assistive aid to go from their wheelchair to the bed and from the bed to the wheelchair.



**Figure 3. Rehabilitation consisting of land-based exercises**

As shown in figure 3, all 3 participants had physiotherapy done either at home or outside of the home. Two participants explained that they use the walking robot to help them with their walking. Other therapy includes occupational therapy.



Lastly, the author asked each participant if they would recommend hydrotherapy to others and each participant answered yes. One participant explained that hydrotherapy has been one of the best rehabilitation methods that they had post stroke.

## 11 CONCLUSION

Combining theory and participants experiences, both have similarities between them. Therapeutic effects of water encourage functional activities, maintains and increases muscle range of motion in joints, strengthens weak muscles, relieves pain and muscle spasms, improves balance, coordination and posture, and educates paralyzed muscles. These improvements are shown in the questionnaire figures. The ability to be independent in the water gives a boost of confidence to the patient. This boost of confidence can also be brought to other forms of therapy. This also was talked about in the interview as well as during the hydrotherapy session.

## 12 DISCUSSION

Even though there is an extensive research base supporting hydrotherapy both within clinical research and basic science research, there is limited amount of theory given to physiotherapists during their studies world-wide. For practical views there are limited number of physiotherapists that have the qualifications and experience in hydrotherapy.

Previous studies have been found that aquatic therapy can achieve optimal mobility in patients with neurological disorders. Six-weeks of aquatic therapy was more effective than land-based exercise in improving balance in older adults, and a 12-week aquatic exercise was beneficial in improving gait and balance in the elderly. In post-stroke patients, an 8-week aquatic exercise was found to significantly increase cardiovascular endurance, maximal workload, gait speed and paretic lower-extremity muscle strength. In 2014, a systematic review of the effectiveness of aquatic therapy indicated that there is “fair” evidence that aquatic therapy improves dynamic balance and gait speed in individuals with neurological disorders, especially those with multiple sclerosis, Parkinson’s Disease and stroke (Zhizhuong, Liling, Miaomiao, Yang, Xiaona, Hongtu, Hua 2016, 588)

The process of writing this thesis has been a great learning experience. The author has not written a bachelors thesis prior to this study program. This process has had its ups and downs. The author suggests that each writer should have a schedule done because it makes the writing process a lot easier and less stressful. One of the difficult parts of writing the thesis was that this topic has different wordings that mean the same thing or are like each other. It was difficult to choose just one word to use throughout this thesis. For this reason, the author did not want the reader to get confused on the wording and have it been used by multiple different words. It was also difficult for the author to find resources that were easily accessible. The author wanted references that were free of charge. It can also be because of the wording that the author used that might have affected the amount of referenced available for this thesis.

With the specificity of the neurological disorder, there were limited number of participants. The author had more interest in stroke out of all the neurological disorders. The author was able to interview 3 participants for this thesis. After interviewing the participants, the author really enjoyed hearing their side of how hydrotherapy has affected their lives and how happy it has made them feel. After the interviews, the author had thoughts about why there was a low usage of the pool as a part of rehabilitation, and after researching why, the author now understands the high demand and responsibility that a physiotherapist must have in order to maintain a pool. Even though there are many pools available to the public, there are not many facilities that offer pools that are a certain temperature for the patient. Most of the public pools have water temperatures ranging from 26°C-29°C and are too cold for patients who have for example spasticity. Most hotels have a spa facility that is open for everyone and the water temperature for most pools are 35°C and over. This temperature is too warm for most patients and is not a good place to go because of the pools being crowded with a lot of people.

The topic of this thesis was the authors personal interest. The author was previously a competitive swimmer for 10 years. The author has also worked with children from the ages of 3-8 years old teaching them how to swim and was a coach for competitive swimmers from the ages of 10-15 years of age. The author has had experiences with children who have a fear of the water, and who are talented in the water. The author knows how to assist children who are afraid of the water and has been there supporting them throughout their milestones. The author has also seen the effects that the water has had on children, some children love the water, and some are not so fond of it. The author has also instructed aqua aerobics. From previous experiences with water, the author wants to expand her learning on other therapies that can be done in water and be able to help others achieve new milestones that have not been achieved for some time.

As the years go on, the author's hopes for an increase use of hydrotherapy is high. The author hopes for a new study course that is made for future physiotherapy students as well as physiotherapists that speaks more deeply about hydrotherapy and gives the opportunity for students to go see a hydrotherapy session. For the future, the author

hopes for an increase in accessibility for therapy pools around Finland for physiotherapists to increase their knowledge of possible new physiotherapy treatment.

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## **Appendix 1**

### Subject information and Informed Consent Form

#### **Introduction**

You are being invited to take part in a research study. This study will be talking about the role of hydrotherapy in neurological rehabilitation. The objectives for this study are to create a questionnaire for clients who have hydrotherapy as part of their rehabilitation and ask about their own experiences. This form explains why I am doing this study and how the treatment that is being offered to you is different from regular physiotherapy. This information will help you decide whether you wish to be part of the study.

#### **What is the purpose of the study?**

The main reason for doing this study is to help answer if hydrotherapy is beneficial in neurological rehabilitation. I have created a questionnaire that consists of questions that ask about a client's own experience in hydrotherapy and how it has affected their lives post stroke, hemiplegia or any neurological disorder. The goal is to get as much information about client's own experiences and if there has been any progress that has happened for example in their range of motion, muscle strength, etc.

The information that is gathered from the interview will be used as an important part of the research and showing the role of hydrotherapy in neurological rehabilitation.

Patients will be anonymous. Patient's name and social security will not be written in the report.

#### **Participants' rights**

You may decide to stop being a part of the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn and destroyed. You have the right to omit or refuse to answer or respond to any questions that is asked of you.

Participant Signature \_\_\_\_\_ Date \_\_\_\_\_