Liam Cook

The Fundamentals of Aquatic Therapy

Contents

- Introduction to aquatic therapy
- Theory of the physical properties of water
- Applications of the properties of water
- The physiological effects of immersion
- Benefits of aquatic physiotherapy
- Contraindications and Precautions to aquatic physiotherapy
- Health and safety
- Examples of exercises

Introduction into Aquatic Physiotherapy

The Aquatic Therapy Association of Chartered Physiotherapists (ATACP) defines Aquatic Physiotherapy as:

"A physiotherapy programme utilising the properties of water, designed by a suitably qualified physiotherapist. The programme should be specific for an individual to maximise function, which can be physical, physiological or psychosocial. Treatments should be carried out by appropriately trained personnel, ideally in a purpose built, and heated pool"

The Role of Aquatic Physiotherapy

- To start a treatment programme
- Integral part of an overall treatment and rehabilitation pathway
- The only treatment offered in a maintenance programme
- Should be patient goal orientated
- Used across all ages
- Used across all abilities, from flicker contractions to elite athlete

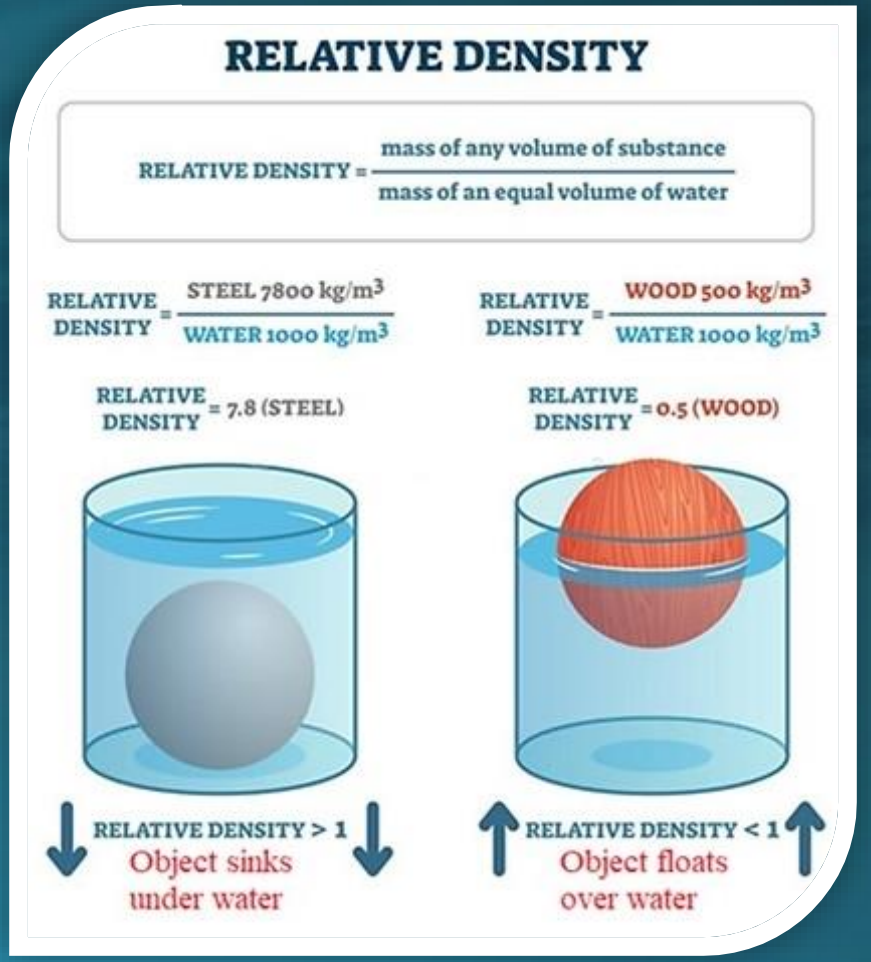
Physical Properties of Water

Hydrostatic pressure

- Increases with depth due to weight of water
- Meaning, a human body standing in water will feel more pressure on the ankles compared to the chest
- There would be an approximate 10% increase in pressure on the ankles in 1m depth of water compared to on land

Relative Density

- Defined as the density of an object or substance relative to the same volume of pure water
- Basically, why some objects float in water when others do not
- Water has a density of 1.0Kg/m³
- Anything more than that will sink
- Anything less than that will float



- The human body (on average) will have a relative density of 0.975kg/m³ with air in your lungs
- If you breathe out, you will most likely sink as this will increase your density beyond the 1.0kg/m³ limit
- Muscle/bone density is more dense and will cause you to sink
- Adipose tissue (fat) is less dense and will cause you to float

Substance	Density
Pure water	1kg/m³
Salt water	1.024kg/m³
Human body (with air in lungs)	0.975kg/m³
Muscle bulk/bone	1.4-1.8kg/m³
Adipose tissue	0.9-0.94kg/m³

Buoyancy

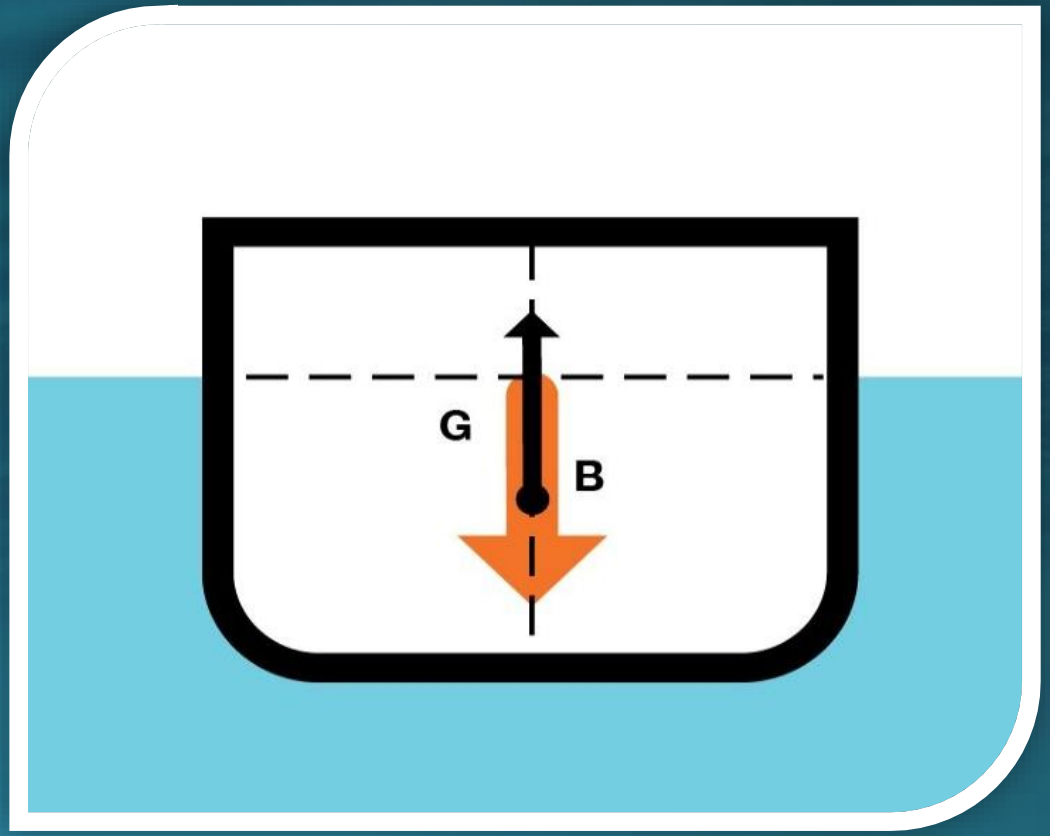
- Is a result of the pressure gradient creating an upward force (upthrust) exerted on an object in water
- It is dependent on the density of the body and the fluid
- In a vertical position, the body is increasingly influenced by upthrust with increasing depth

Stability in Water

A body immersed in water is subject to two opposing forces:

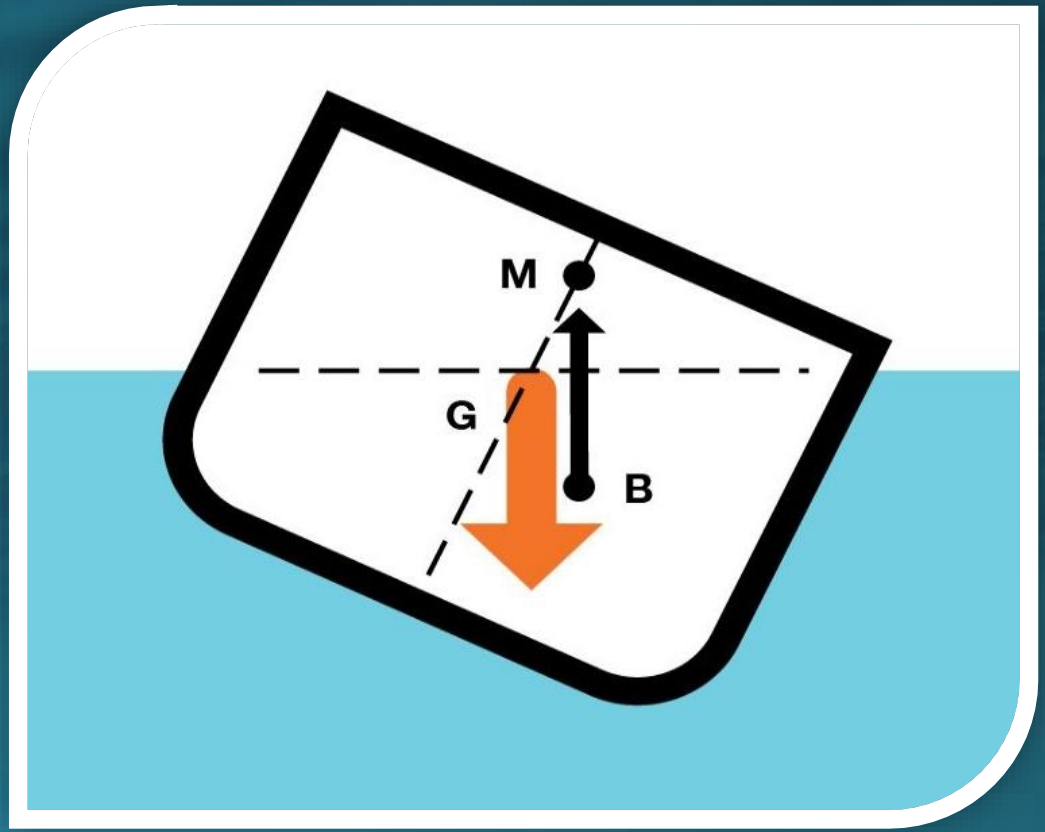
- Gravity acting downwards
- Buoyancy acting upwards

- When these are aligned, the body is stable in water
- This is known as stable equilibrium



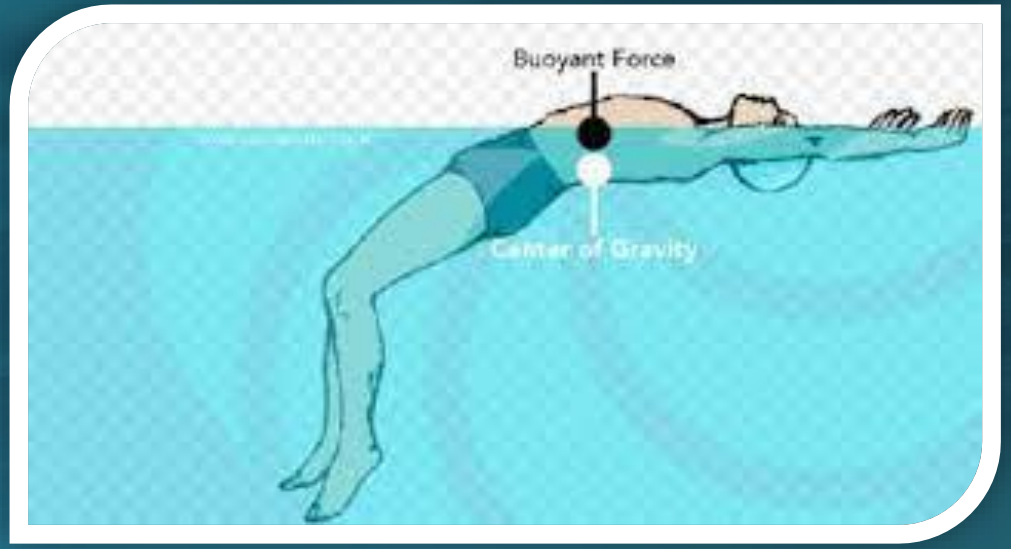
Metacentric effect

- However, if the centre of buoyancy moves away from the centre of gravity instability ensues
- Using someone floating on their back in water as an example, even lifting one hand out of the water will move the centre of buoyancy
- As a result, torque is created which rotate the person into the water
- This is known as the metacentric effect



Application of Metacentric effect

- Firstly, understanding this effect will bring awareness of how we can keep our patients safe
- It is important to find the point where the centre of buoyancy meets the centre of gravity for each individual as it changes from person to person
- Once this is identified, you can be aware of what positions will capsize the individual
- However, we can also use the metacentric effect to strengthen our patients
- When floating in supine asking the patient to lift their hand out of the water will cause a rotation – resistance to this rotation will be working the core



Hydrodynamics

- Laminar flow – low velocity, all layers of water moving at the same speed in smooth, straight line

- Turbulent flow – higher velocity, uneven movement of water layers with a resultant loss of energy from frictional resistance

Application of Hydrodynamics

- Understanding hydrodynamics means that you can implement the use of it in sessions
- Laminar flow allows for a lower level resistance exercise
- Turbulence can be used to either assist OR resist patient
- For example, walking in front of a patient in water will assist the patient as the therapist is taking the 'brunt' of the column of water
- Additionally, negative pressure is created behind the therapist which will actually pull the patient in the water

Resistance to Movement

90% of DRAG effect:

- Negative pressure of the turbulence behind the object
- Skin friction
- Size of column of fluid in front of the object

Other 10%:

- Bow wave
- Viscosity
- Cohesion
- Surface tension

Resistance is dependent on:

- Speed of movement
- Amount of the object below the water
- Shape of the moving object

Resistance is increased by:

- Increasing speed
- Decreasing streamline
- Increasing lever length
- Changing direction quickly

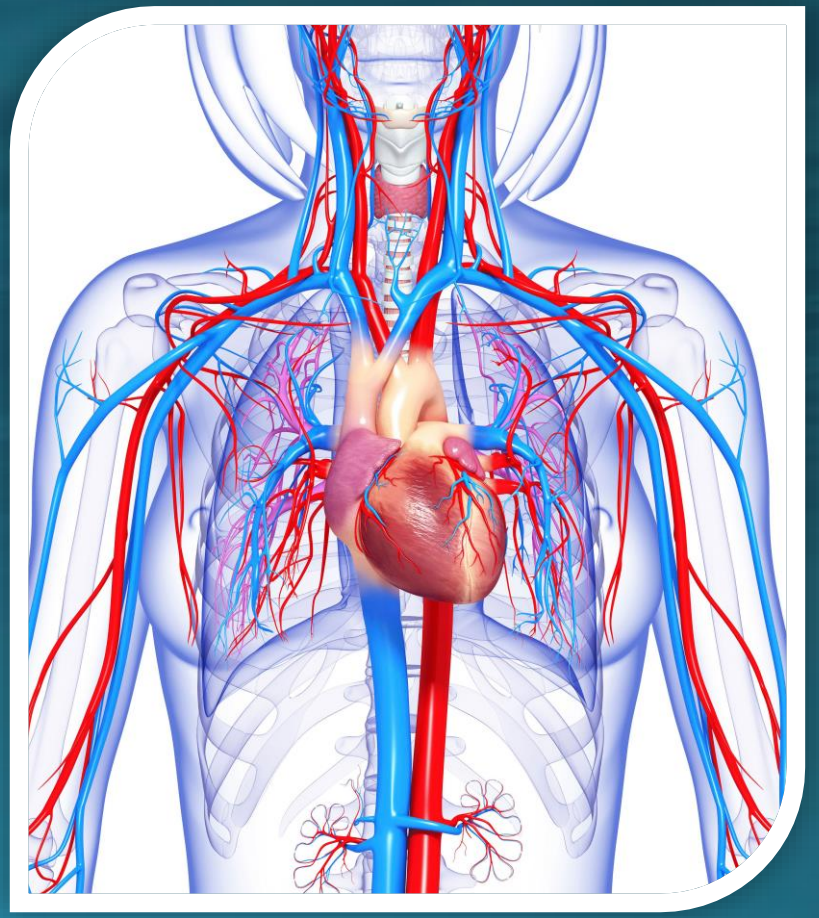
The Physiological Effects of Immersion

Hydrostatic pressure effects the following systems:

- Cardiovascular
- Pulmonary
- Renal
- Haematological
- Central and peripheral nervous
- Musculoskeletal

Cardiovascular System

- In standing, hydrostatic pressure causes 700mls of blood to shift from lower extremities to cardiothoracic compartment
- Causes a 60% increase in central blood volume
- Increases heart size by 30% in 6 seconds
- Cardiac output increase by 18% to 34%
- Stroke volume increases by 35% to 50%
- Blood pressure remains stable (or a slight drop)
- Cerebral blood flow is positively improved
- In supine lying, approximately 400-500mls



Pulmonary System

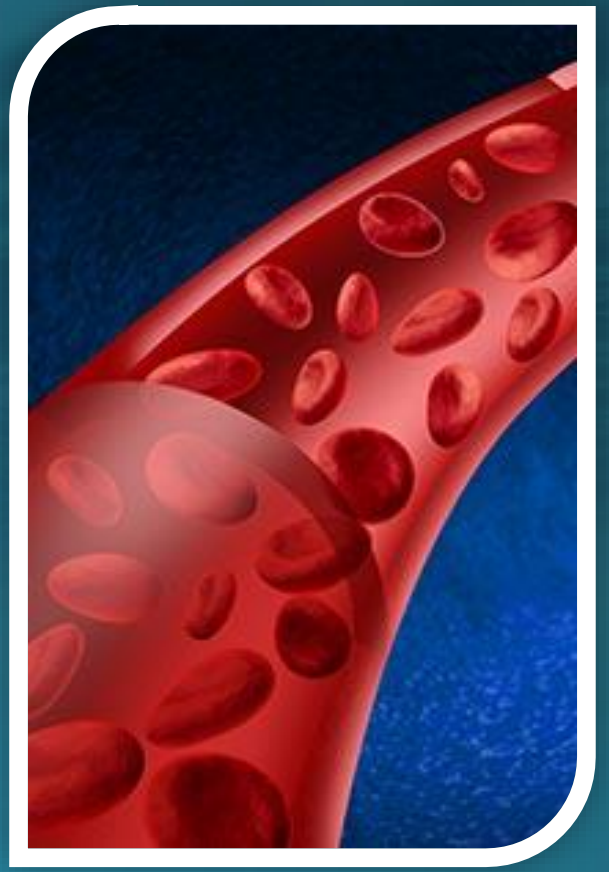
- Direct hydrostatic pressure on the thorax causes reduced diffusion capacity and displacement of the diaphragm
- Vital capacity decreases by 6-9%
- Expiratory reserve volume decreased by 75%
- Total lung capacity decreases 3-10%
- Functional residual capacity decreases by 54%
- Airway resistance increase by 58% due to reduced lung volume
- Increased work on primary and accessory respiratory muscles

Renal System

- Increase in blood flow caused by hydrostatic pressure floods the kidneys
- Diuresis occurs, meaning an increase in sodium and potassium excretion
- Urine output increases by 700% (from 1ml/min to 7ml/min)
- Really important to hydrate pre and post session due to increased loss of fluid
- The body will also look to replace lost sodium and potassium

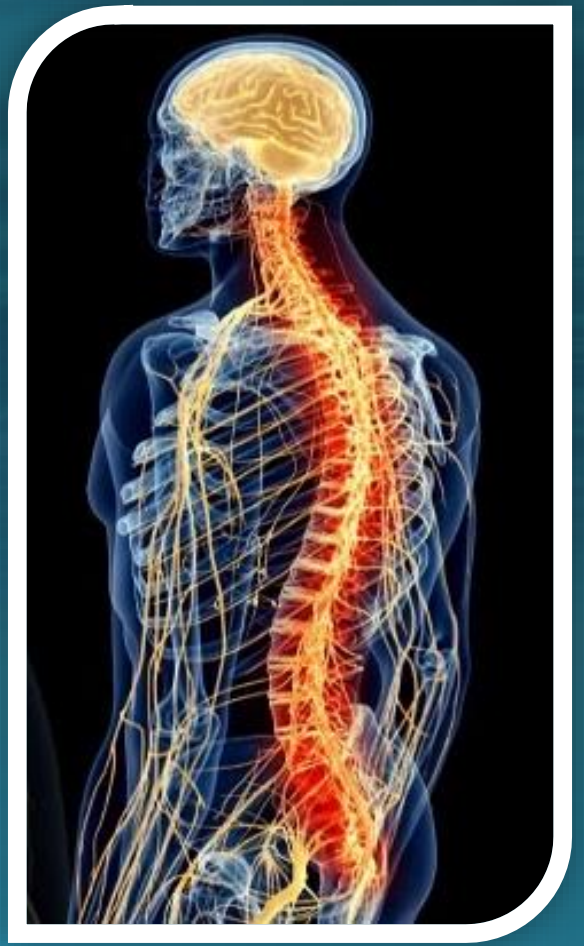
Haematological System

- Haemodilution occurs which is a 'thinning' of the blood
- Fluid shifts from interstitial to intravascular tissues
- Plasma volume increases by approximately 120mls after 20 minutes
- It is theorised that this process may be beneficial for people who suffer with diseases that increase blood viscosity – e.g. Rheumatoid arthritis
- Reduction in haemoglobin, haematocrit, red cell count and albumin concentration in 30 mins



Central and Peripheral Nervous Systems

- Touch, temperature and pressure nerve receptors affected by immersion causing ‘sensory overflow’
- Meaning, sympathetic nervous system is suppressed in warm water
- Increase in central blood volume stimulates baroreceptors which will trigger a release of Noradrenaline
- Noradrenaline is a neurotransmitter that can cause a reduction in ischemic pain through vasodilation, interrupt the pain cycle and reduce the inflammatory response



Musculoskeletal System

- The increased cardiac output blood is redistributed to the skin and muscles
- Resting muscle blood flow increases from 1.8ml/min/100g to 4.1ml/min/100g
- This increases oxygen delivery to the muscles
- Also increases circulatory drive to remove muscle metabolic waste products
- Additionally, buoyancy offloads soft tissues and joints which provides protection during exercise

Benefits of Aquatic Physiotherapy

Benefit	Reason
Pain relief and reduction of muscle spasm	• Warmth of water • Suppression of sympathetic nervous system • Stimulation of nerve endings (sensory overflow) • Reduced effect of gravity
Ease of movement, joint range, and flexibility	• Support of buoyancy • Reduced effect of gravity
Reduction of oedema and improved circulation	• Hydrostatic pressure • Ability to move more freely
Improved strength and endurance	• Viscosity of water • Drag effect • Negative pressure from turbulence • Weight and density of water • Force of buoyancy
Re-education of functional activities/balance/co-ordination/posture	• Unencumbered • Metacentric effect • Support of buoyancy and variation in weight-bearing • Assistance or resistance to movement
Improved cardiovascular fitness	• Hydrostatic pressure • Resistance to movement • Opportunity to exercise
Enhanced relaxation	• Reduced effect of gravity • Support of buoyancy • Reduction in pain • Hypnotic effect of water
Enhanced feeling of well being	• Ability vs Disability • Social interaction • Enjoyment • Independence

Contraindications

- Diarrhoea and/or vomiting – minimum of 48 hours of clearance since last episode
- Medical instability without medical clearance – MI, CVA, DVT, PE, status asthmaticus
- Unstable angina – prolonged symptoms at rest (>20 mins), new onset, symptoms not responding to GTN spray
- Uncontrolled cardiac failure, epilepsy, diabetes, BP issues
- Acute systemic illness associated pyrexia (flu, TB, Virus) – temperature > 38oC less than 24 hours before session is contraindicated
- Weight in excess of emergency evacuation equipment

Precautions

- Compromised cardiorespiratory/renal/immune system
- Impaired skin integrity
- Incontinence
- Infectious conditions
- Impaired vision/hearing/sensation
- Challenging behaviours
- Invasive lines – catheter
- Pregnancy
- Transdermal patches

Health and Safety

Key points:

- Provide information and training
- Provide safe workplace
- Provide safe working environment

Infection, Physical and Chemical Control

- Infection control – common infection include: skin, ear, eye, throat and gastrointestinal. Pool management will ensure correct level of protection against infection using chemicals; however, we should be screening our patients for illness and open wounds. Showering before and after is a must!

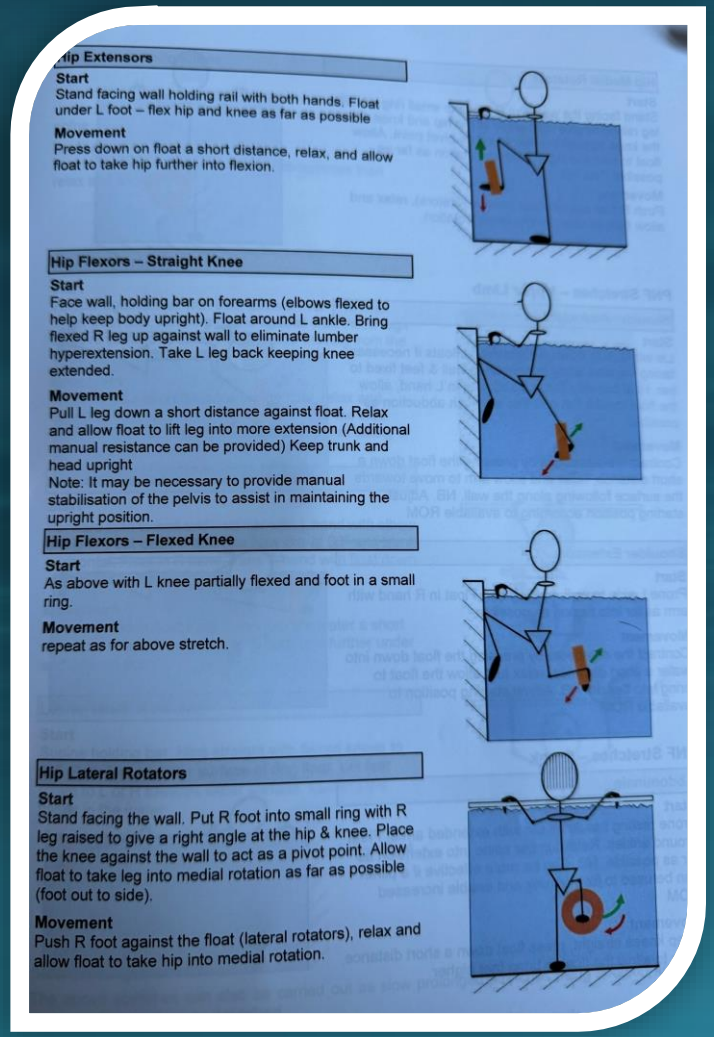
- Physical injury – Along with the training we have undertaken, we need to ensure that slips and falls risks are kept at a minimum. It is our responsibility to keep our clients and ourselves safe, so be wary of dangerous walkways!

- Chemical injury – regulated by pool staff 3 times a day, but any signs of chemical injury need to be reported immediately!

Risk Assessment

Environment	Staff & Patients
Slippery surface/excess water	Staffing levels & training
Walking aids	Emergency procedures
Submerged objects/available pool space	Manual handling
Faulty equipment	Pool user screening (including patients)
Pool chemistry and temperature	Fatigue (prolonged immersion/humidity/temperature)
Lighting	Accidental submersion
Microbiology	Challenging behaviours
Air humidity	Dehydration

Exercise examples



Hip Extensors

Start
Stand facing wall holding rail with both hands. Float under L foot – flex hip and knee as far as possible

Movement
Press down on float a short distance, relax, and allow float to take hip further into flexion.

Hip Flexors – Straight Knee

Start
Face wall, holding bar on forearms (elbows flexed to help keep body upright). Float around L ankle. Bring flexed R leg up against wall to eliminate lumber hyperextension. Take L leg back keeping knee extended.

Movement
Pull L leg down a short distance against float. Relax and allow float to lift leg into more extension (Additional manual resistance can be provided) Keep trunk and head upright
Note: It may be necessary to provide manual stabilisation of the pelvis to assist in maintaining the upright position.

Hip Flexors – Flexed Knee

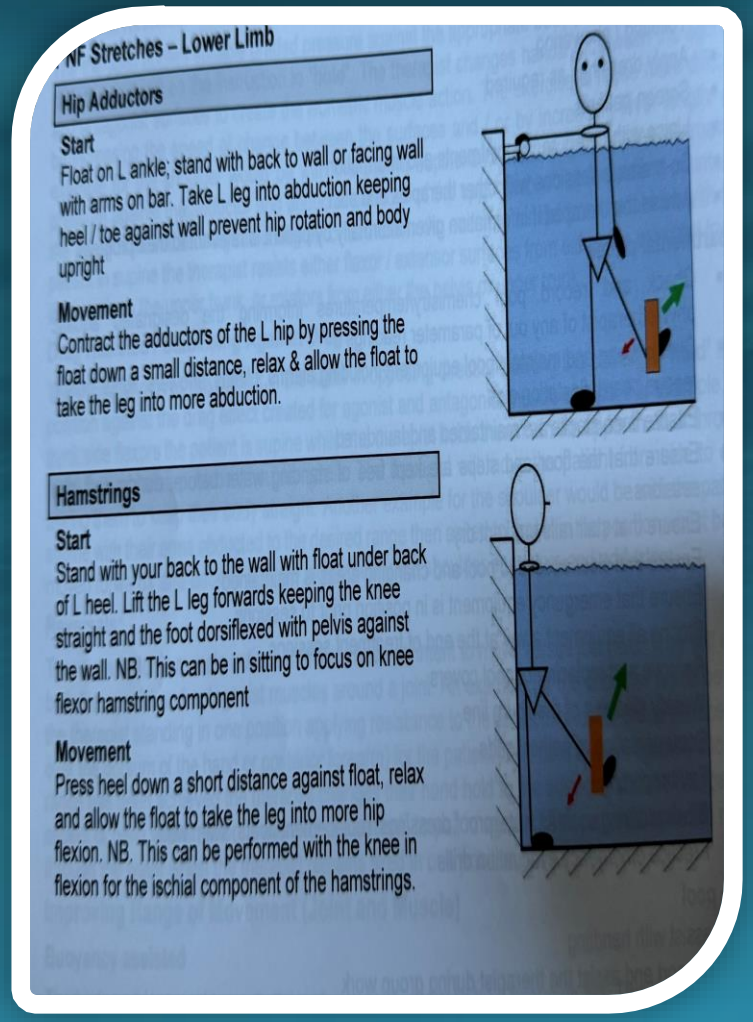
Start
As above with L knee partially flexed and foot in a small ring.

Movement
repeat as for above stretch.

Hip Lateral Rotators

Start
Stand facing the wall. Put R foot into small ring with R leg raised to give a right angle at the hip & knee. Place the knee against the wall to act as a pivot point. Allow float to take leg into medial rotation as far as possible (foot out to side).

Movement
Push R foot against the float (lateral rotators), relax and allow float to take hip into medial rotation.



PNF Stretches – Lower Limb

Hip Adductors

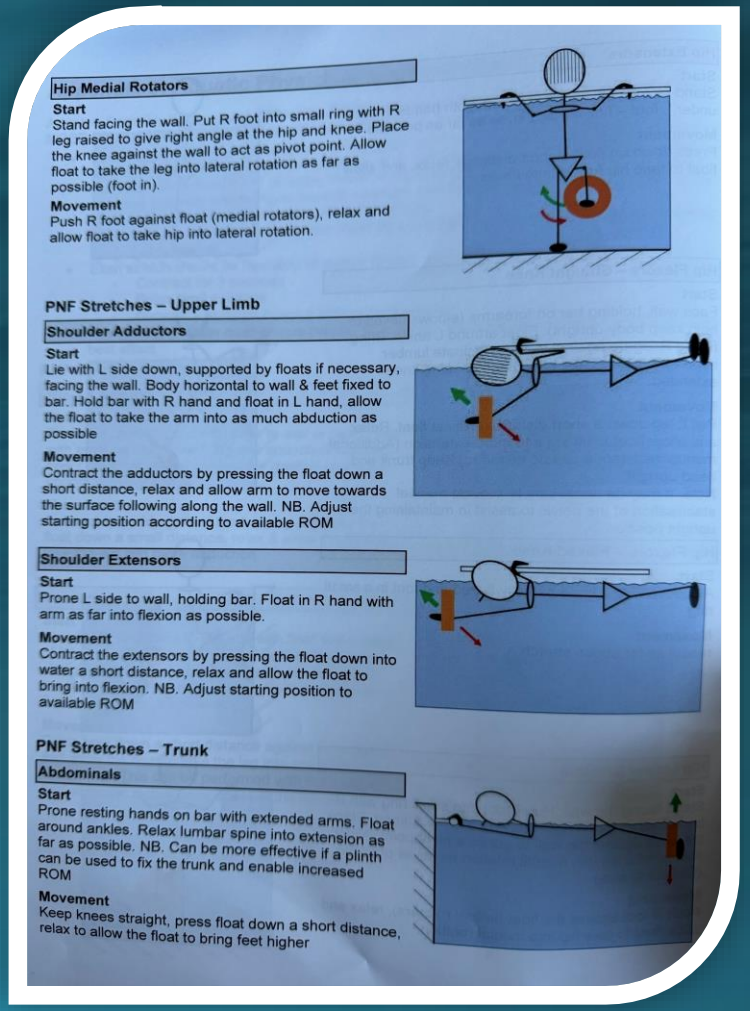
Start
Float on L ankle; stand with back to wall or facing wall with arms on bar. Take L leg into abduction keeping heel / toe against wall prevent hip rotation and body upright

Movement
Contract the adductors of the L hip by pressing the float down a small distance, relax & allow the float to take the leg into more abduction.

Hamstrings

Start
Stand with your back to the wall with float under back of L heel. Lift the L leg forwards keeping the knee straight and the foot dorsiflexed with pelvis against the wall. NB. This can be in sitting to focus on knee flexor hamstring component

Movement
Press heel down a short distance against float, relax and allow the float to take the leg into more hip flexion. NB. This can be performed with the knee in flexion for the ischial component of the hamstrings.



Hip Medial Rotators

Start
Stand facing the wall. Put R foot into small ring with R leg raised to give right angle at the hip and knee. Place the knee against the wall to act as pivot point. Allow float to take the leg into lateral rotation as far as possible (foot in).

Movement
Push R foot against float (medial rotators), relax and allow float to take hip into lateral rotation.

PNF Stretches – Upper Limb

Shoulder Adductors

Start
Lie with L side down, supported by floats if necessary, facing the wall. Body horizontal to wall & feet fixed to bar. Hold bar with R hand and float in L hand, allow the float to take the arm into as much abduction as possible

Movement
Contract the adductors by pressing the float down a short distance, relax and allow arm to move towards the surface following along the wall. NB. Adjust starting position according to available ROM

Shoulder Extensors

Start
Prone L side to wall, holding bar. Float in R hand with arm as far into flexion as possible.

Movement
Contract the extensors by pressing the float down into water a short distance, relax and allow the float to bring into flexion. NB. Adjust starting position to available ROM

PNF Stretches – Trunk

Abdominals

Start
Prone resting hands on bar with extended arms. Float around ankles. Relax lumbar spine into extension as far as possible. NB. Can be more effective if a plinth can be used to fix the trunk and enable increased ROM

Movement
Keep knees straight, press float down a short distance, relax to allow the float to bring feet higher

To Conclude…

- The physical properties of water can be used to aid strengthening, flexibility, gait and posture
- Hydrostatic pressure causes many beneficial physiological effects
- Health and safety, contraindications and risk assessments are also considered a priority
- All information included within this presentation is taken from the ATACP course handbook, for more information please click here- https://atacp.csp.org.uk/

Any Questions?