Aquatic Exercise for Functional Improvement Part 1

Asimenia Gioftsidou
Assistant Professor
School of Physical Education and Sport Science
Democritus University of Thrace

Aquatic Environment

Water has certain attributes that make it superior to air as a medium for exercising

- The buoyancy of water partially suspends the body. Hence, balance is more easily maintained, and **risk of falling is less**. Also, if one does fall, the results are less damaging.
- Water, being denser than air, gives **increased resistance** to movement – in any direction
- **Sensory feedback** from water makes it ideal for retraining the proprioception

Aquatic Environment

- The use of the **aquatic environment** for exercise is **beneficial** to the trainee, since the program designer understand the **principles** of the aquatic environment.

they dramatically affect each exercise.

- For example, we rarely consider the resistance of air when we do a leg lift **on land**. We assume that all of the resistance is provided by the **effect of gravity on the leg**.
- When this exercise is performed **in water**, however, the effect of gravity is opposed by the **force of buoyancy**. Therefore, most of the resistance to movement actually comes from the **fluid resistance of the water**

All aquatic exercise routines must address two important factors:

- the body's **physiological response** to being immersed in water and
- the physical properties of water

Physical properties of the water

Several basic principles of physics must be considered when water is used for exercise

- Relative density (Specific Gravity)
- Buoyancy
- Fluid resistance
- Movement through water
- Hydrostatic pressure

Relative density (specific gravity)

The relative density of an object is the property that determines whether the object will float.

The relative density is the ratio of the weight of the object to the weight of an equal volume of water.

- If this value is **greater** than 1, the object will **sink**
- If is **less** than 1, the object will **float**
- If the value is exactly 1, the object will float just below the surface of the water

Relative density (specific gravity)

The relative density of a body depends on its composition

The specific gravities of **fat** is **0.8**,

of **bone** is **1.5** to **2.0** and

lean muscle is **1.0**

Lean people tend to **sink** and **obese** people tend to **float**

Generally, women have more body fat than **men**, so they tend to float

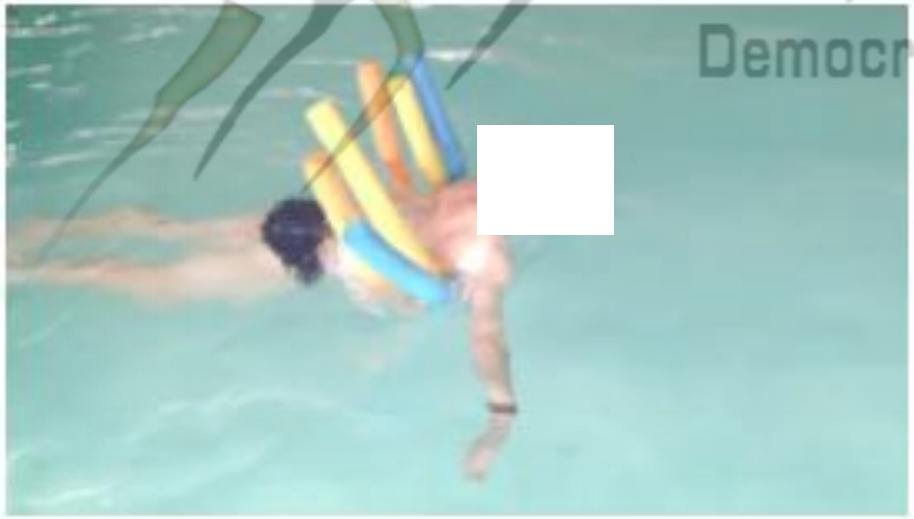
Relative density (specific gravity)

As people age, they usually float more easily

their **bone density** tends to decrease ↓

their percent of **body fat** tends to increase ↑

their **muscle mass** tends to decrease ↓



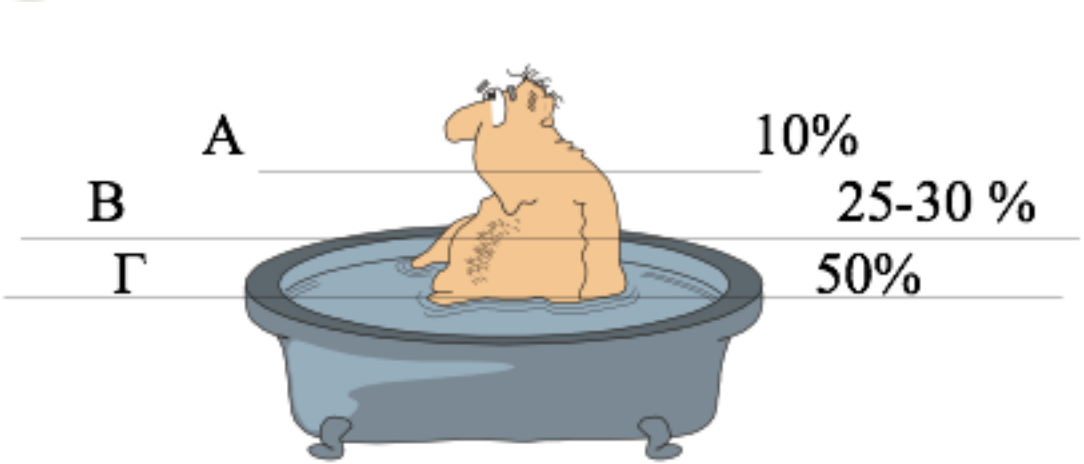
Buoyancy

Buoyancy provides many benefits for water exercisers.

- It **decreases the effects of gravity** and reduces weight bearing or compression of joints.

A body immersed to the **neck** bears approximately **10%** of its body weight,

- a body immersed to the **chest** bears **25-35%,** and
- a body immersed to the **waist** bears about **50%**



Buoyancy

Because the force of buoyancy is **vertically upward**, any buoyed movement **toward** the **surface** of the pool is **buoyancy assisted**.

Any movement of a buoyant object **toward** the pool **bottom** is **buoyancy resisted**.

Buoyancy

Any floating movement **on the surface** of the water is buoyancy **supported**.

Viscosity – fluid resistance

- Viscosity refers to the friction between molecules of a liquid, causing the molecules to tend to adhere to each other **(cohesion)** and, in water, to a submerged body **(adhesion).**
- This friction between molecules, or the water's viscosity, is what causes resistance to motion.
- Because water is more viscous than air, water provides more resistance to motion than air.
- As Galileo discovered, friction or viscosity causes an object to fall slower through water than air.
- He found that a combination of the surface area of an object and its speed determines the resistance to the motion caused by the fluid viscosity (drag).

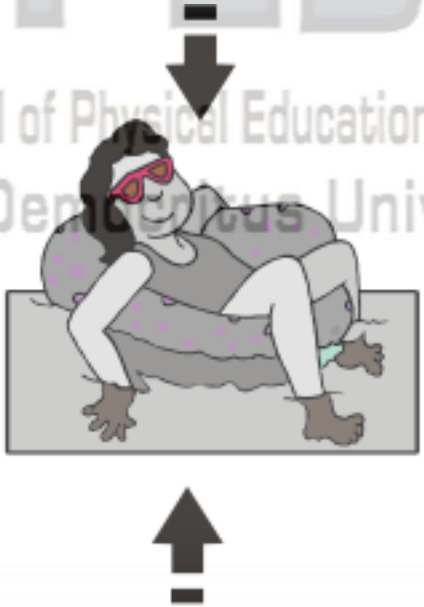
Drag – movement through water

- The resistance you feel to movement in the water
- Is a function of fluid characteristics (viscosity), frontal shape and size, and the relative velocity between the participant and the water.
- The results of drag makes a very different loading to the muscles during exercise in the water compared to land exercise.
- On land, your muscle load decreases when you achieve a constant speed. In the water, you have a constant muscle load provided by the water through full range of motion.

Frontal resistance

In water, gravity is not the primary force acting on the body because the vertical downward pull of gravity is offset by the upward vertical force of buoyancy.

Vertical downward pull of gravity



Upward vertical force of buoyancy

Frontal resistance

- Frontal resistance is another factor affecting exercise intensity, results from the **horizontal forces of the water**.
- **On land**, the primary force acting on the body is the downward vertical force of **gravity**. The horizontal resistance of air can be felt when trying to walk forward against a strong wind.
- However, the horizontal resistance of water is very noticeable because of water's viscosity.
- In a sense, walking through water can be like walking through a brisk windstorm.
- The size of the **frontal surface area** of an object presented against the water's horizontal resistance affects the amount of **energy** required to move the object through the water.

Frontal resistance

- In water exercise, the **resistance** of the water increases with the **speed** or **velocity** of movement.
- When **speed** is increased, range of motion and body position can be compromised.
- The most effective way to train a muscle is **through a full range of motion**.
- It is also difficult to push against the water's resistance in all directions of movement when using fast, ballistic movements.

Hydrostatic pressure

The hydrostatic pressure is directly proportional to both the depth and the density of the fluid.

Hydrostatic pressure affects internal organs of the body as well as the skin.

Hydrostatic pressure can **decrease swelling** and pressure, especially in the lower extremities that are immersed deeper.

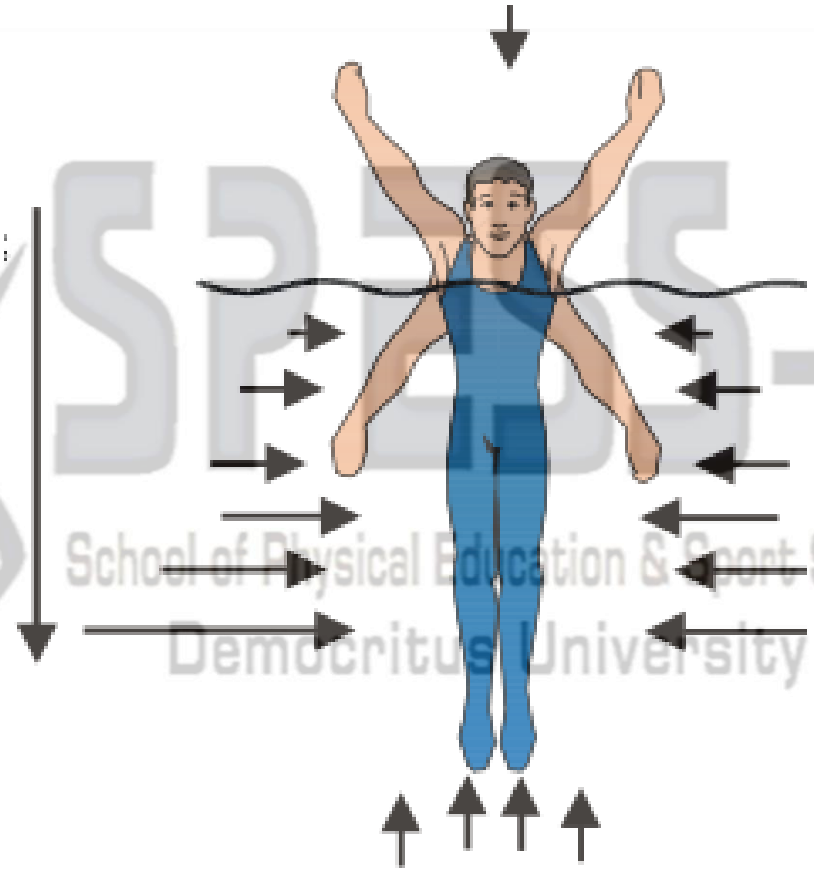
The pressure offsets the tendency of blood to pool in the lower extremities during exercise and aids **venous return** to the heart.

Hydrostatic pressure helps **stabilize** unstable joints

BUT patients with chronic obstructive **pulmonary disease** may have **difficulty breathing** because the pressure of the water resists chest wall expansion.

Gravity effects

Hydrostatic pressure increases with the depth of water



The force of buoyancy is vertically upward

Aquatic Environment

- The water is a very complicated environment, offering numerous benefits as an exercise medium. The physiological responses to water immersion are affected by additional factors:
- • Water temperature
- • Water depth
- • Body composition
- • Intensity of exercise (rest, submaximal exercise, or maximal exercise)
- • Individual participant factors (age, sex, disease, and so on)

Aquatic Environment

- Aquatic environments and pool temperatures can vary from facility to facility as well as from day to day.
- Water varying from 28 to 30 degrees Celsius is the most comfortable temperature for typical water fitness programs.
- Water temperatures near or above 32 degrees Celsius is too warm for moderate to vigorous exercise programs.
- Is better suited for therapeutic-type activities, such as range-of-motion and strength/rehabilitation exercises for musculoskeletal injuries.
- This water temperature also works well for water tai chi, Pilates, yoga and stretching programs.

Aquatic training equipment

An increasing variety of fitness equipment is available for use in aquatic training.

Some of this equipment is used in land fitness and can be brought into the aquatic environment, whereas other equipment is developed specifically for use in the water.

Before adding equipment to your aquatic program, you should recognize the purpose of the equipment, be aware of all safety considerations, and understand how the equipment will alter training results.

What is the purpose of the equipment? Do you need equipment to aid in stretching, to build muscular strength, or to achieve neutral buoyancy?

Aquatic versus Land movement

- **Movement on Land:** Movement on land is affected by the pull of **gravity**, which is a vertical vector that pulls toward the center of the earth. Any movement performed away from the ground is gravity resisted. Any movement performed toward the ground is gravity assisted.
- **Submerged Movement:** Submerged movement is affected by the environmental conditions imposed by the water. The primary force affecting movement in the water is the water's viscosity or drag. The water surrounds you and affects movement in **every direction**, therefore every movement in every plane is resisted in the water.

Types of Aquatic Equipment and Muscle Actions

Proper use of equipment involves understanding the function, purpose, limitations, properties, safety factors, and biomechanics of the equipment.

Aquatic equipment falls into five general categories:

- Buoyant
- Flotation
- Drag
- Weighted
- Rubberized

Buoyant Equipment

This equipment is comprised of a material such as dense **closed-cell foam** that floats in the water, or is filled with **air**.

Although lightweight on land, buoyant equipment can create a great deal of resistance in the water.

It interacts with the forces of buoyancy.

Flotation Equipment

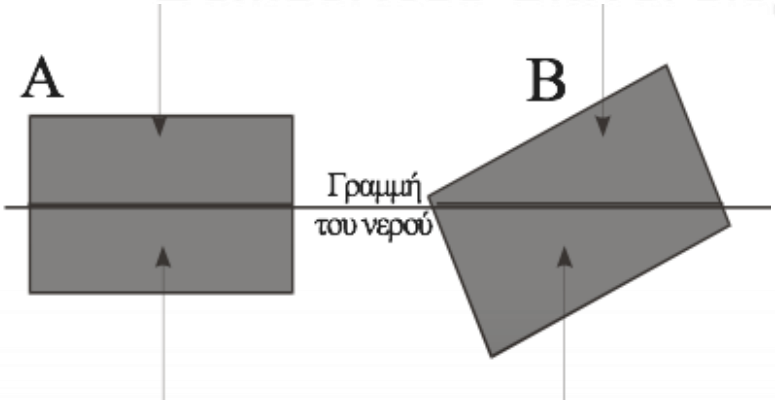
Flotation equipment used to create **neutral buoyancy**.
There are many types of flotation belts available for use in deep water.
Participants will want to use some type of neutral buoyancy to help maintain **vertical alignment** in **deep-water exercise**.

Buoyancy and flotation devices

The point through which the buoyant force acts is called **center of buoyancy**. It is an upward thrust that acts in the directions **opposite** to that of the force of gravity

With the use of **flotation devices** sometimes the center of buoyancy and the center of gravity are not in the same vertical line….. and **roll over** or **turn** until it reaches **equilibrium**.

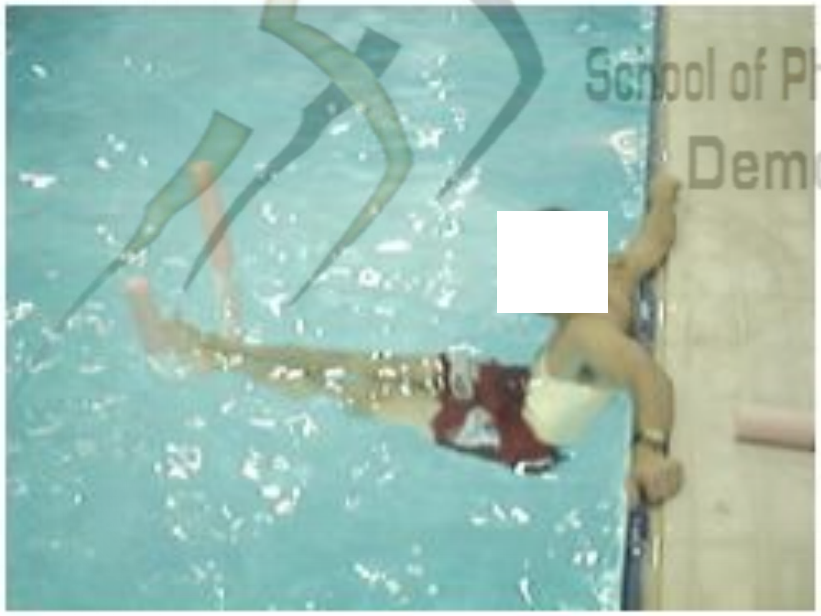
Vertical downward pull of gravity

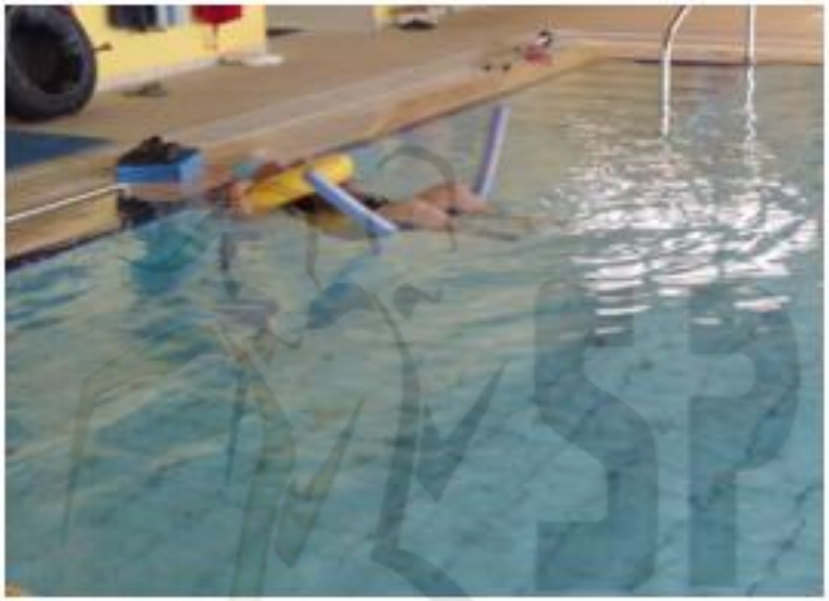


Upward vertical force of buoyancy

Flotation Equipment

Flotation equipment can be used for **stretching** and **relaxation** programs allowing free movement in deep water





Drag Equipment

Drag equipment usually **increases the surface area** to create additional resistance for muscle action.

Drag always opposes the direction of movement.

The force of drag can potentially be in any direction depending on the exercise movement.

The amount of **resistance** created by a piece of drag equipment is based on the **frontal surface area**, **shape**, **velocity** or **speed** of the movement

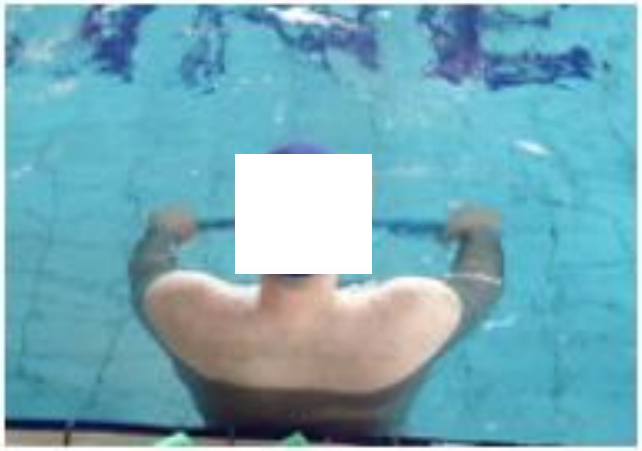
Equipment

Resistance

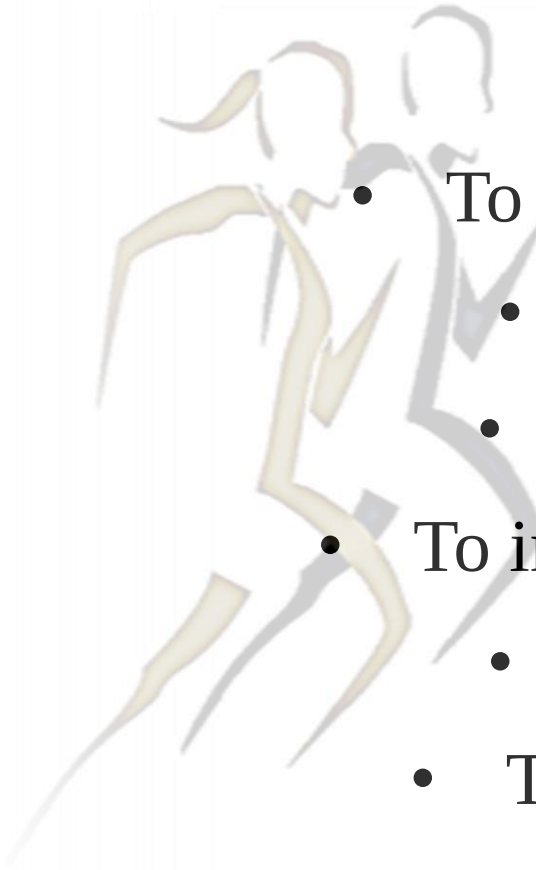
rubberized

drag

buoyant



Which one is the aim of the EXERCISE?



- To increase aerobic condition ???
- To improve mobility ??
- To improve flexibility ??
- To improve the muscle strength ???
- To improve stability ???
- To improve functional ability

or ……. to relax

Pool depth and slope

- Some pools, such as lap pools, vary little in depth, usually around 1.4 m
- A slightly greater depth range of 0.9 to 1.5 meters will assure that most all participants can safely and comfortably participate.
- Other pools may begin at 1 m and end at 3.05 m or more.
- Pools with a depth of 2m and deeper can provide ideal conditions for deep-water exercise.

Pool depth and Exercise

- **Shallow-water** (1-1.5m)**:** aerobics, walking or jogging, aquatic steps, balance exercises, mobility exercises, strength and stretching exercises

- **Deep-water (**2m and more): aerobic condition exercises, swimming, mobility exercises, strength exercises