

Physical Activity In The Water And The Human Body

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The purpose of the presented thesis is to cover the basics of what happens to our bodies and psychological state when we perform physical activity in the water and just being in the water. The goal is to get the reader to see water in a new way, especially if they have a phobia of anything related to being in the water or drowning, which causes them to fear water instead of enjoying it. The second goal of this thesis is to introduce sport coaches to the overlooked benefits that water and water exercises can give to their athletes, such as rehabilitation and training, all outside the gym and dryland.

Methods used for writing this thesis were literature books on aqua fitness programs, internet research, and a questionnaire for people who swam and worked at the pool. The entire thesis process took about 6 months to do and ended in a conclusion of a twist in my hypothesis about how physical activity benefitted the most to the people who took part in the questionnaire.

Briefly, the research of this thesis will explain water, what it does to the body, finding the right temperature of water for a desired activity, health cautions concerning water. General benefits of water including the physical and mental parts with a subchapter on the history of how water benefitted people in the past, all the way from the B.C century. Then a chapter on water concerning the athletic body, which is a good chapter for coaches who want to know more on what water could do to their athletes, with subchapters such as hydration and how water affects the muscles, building strength doing exercises in the water, and preventing injuries in the water. The next chapter shows different types of common water exercises starting from hydrotherapy, water fitness, swimming, and rehabilitation, ending with interesting theory on why heart rates are lower in the water than on dryland when exercising. Second to last chapter will discuss the physical laws and properties of water which is buoyancy, hydrostatic pressure, viscosity, thermoregulation. Those are the laws and properties that do all the changes to the body.

The last chapter is a poll that asks water fitness instructors and their clients, swimmers, swimming coaches, and just overall water lovers about the benefits that physical activity in the water brought them or their clients. The discussion part reviews the whole thesis, what research stood out the most, what new knowledge was found about physical activity in the water, and ending it all with the process of the thesis and self evaluation of learning this topic.

Keywords

Water, human body, sports, hydrotherapy, water fitness, water sports, rehabilitation, water exercise, swimming, psychology, strength training, thermoregulation, hydrostatic pressure, water exercise

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Introduction

People who are actively participating in their choice of sport, don't usually look deep in what's happening to their bodies and minds while performing it, everything is basically just done on autopilot like it was trained. Some people don't try out a sport based on their lack of knowledge of the basics of the sport and the things that have been overlooked because of a shared opinion by other people. The question of this thesis was how physical activity in the water affect the body, including the mind. Objectives of this thesis were to show and teach how water isn't just one of the phobias, and what happens with the entire body (Inside and out) and mind when performing physical activity in the water. With dryland activities and sports being more famous, water exercises are being overlooked because of everyone associating water with drowning or just a low-intensity workout place that won't give much results as a gym or a running track would. If people knew more about water and especially it's properties, it would be possible that there would be less phobias of it because being in the water should not cause any problems as long as water safety rules are known and followed, information about the exercises is given, and instructors having the proper knowledge. In the chapters, the thesis will open up all of the things needed to make sure the pool would be a comfortable place to do any sort of physical activity.

This thesis will first cover water in general, including how it affects our body, health cautions with it, and finding the right temperature. Moving forward, the other chapters will combine water and the athletic body, which is a special chapter for coaches of dryland sports to see what adding water programs to training could do, how it will give a variety for practices, the importance of water intake during practices (Hydration), preventing injuries in and out of the water, and building strength using the water. The upcoming chapters will then cover the common water exercises and programs, with a

description of each one of them, and ending with a theory on why heart rates in the water are lower than on dryland. Second to last chapter covers the most important information about water's laws and properties, which basically do all the changes to the body when an exercise is performed. The thesis ends with a questionnaire on how physical activity in the water benefited the people were being asked about that. The questionnaire was a good way to prove in what ways did physical activity in the water help other people and the number of people who experienced it.

The main objective of this thesis is to change the reader's view of water and water exercises, or learn more about how the body's reaction when being physically active in the water. The thesis is mostly aimed at readers with little knowledge about the effects of anything related to water, and it's benefits to the body and mind, but can also be useful for water sport coaches who want to give an insight about physical activity in the water to their athletes. This thesis should also influence many coaches to think about adding water-based programs and widen their knowledge about different types of exercises that can be added to their trainings. As a swimming coach, doing all the research on this topic feels like a new step forward in my career path because of the new things learned related to my field of studies and passion of coaching swimming.

1) Water

Water is the most common liquid on earth, but also the most important. It is everywhere on earth – Air, clouds, oceans, lakes, rivers, ice, plants, animals, and beneath earth's surface. If there was no water, there would be no life. Not only is it important to our planet, but it is also crucial to people (Simon S., 2017, p.5). Water has withstood the test of time by being used therapeutically, medically, and recreationally. Some people still remain sceptical about water being a medical intervention, but with more education and experience, more providers will better understand the benefits of water-based rehabilitation and training (Lori Thein Brody, 2009, p.14).

Water has been chosen by people for a variety of different reasons. It is the weightlessness sensation, ease of movement from buoyancy, feeling of support, force from the hydrostatic pressure, the viscosity of water, or simply the experience of being in the water (Lori Thein Brody, 2009, p.4).

1.1 Water And The Human Body

Water regulates the temperature of the human body, carries nutrients and oxygen to the body cells, removes wastes, and protects organs and tissues. The human body is practically made of water. We can live for a month without food, but could only survive about a week without water. The human body is practically made of water (Simon S., 2017, p. 5). In our bodies, water is the main substance. 80% of a new born baby's weight is water and almost 2/3 of an adult's weight is water. If our bodies were to ever lose even 10% of the water, it would make any human seriously ill, there wouldn't be any people, animals, plants or living things on earth (Simon S., 2017, p.15).

Water is a vital nutrient for the life of every cell in the body, as it is needed to build new cells and keep old cells alive. It carries the proteins and carbohydrates from food through our bloodstreams, through sweating it regulates

our internal body temperature, it flushes waste from the body through the kidneys, helps digest food through saliva that it forms, and water is like a shock absorber for the brain, spinal cord, and for an unborn fetus (Simon S., 2017, p.15).

1.2 Choosing The Right Water Temperature

There are certain water temperatures for each type of water exercise. Programs that are slow and have controlled movement, such as strength, toning, and stretching, require slightly higher water temperatures which are about 30-31°C. For more fast paced programs such as swimming, only 22-25°C is acceptable. This temperature would be too cold for a different exercise program due to the risk of injury (Jill E. White, 2010, p. 85). In other words, if the water is cooler, then there must be an increase in the activity and intensity level. If the water is warm, everything must be done slow (Jill E. White, 2010, p. 87).

Typical water fitness temperature is 28-30 °C. It is moderately warm, allowing the body to react and respond normally to the given exercise and increase in the body during it. With cooler water temperatures about 26°C, the metabolic and heart rate slow down, circulatory functions become slower, and most of the body fluids remain in the trunk area to keep essential organs warm and functioning. Reduced circulation causes cold muscles, which then leads to inflexibility and an increasing risk of injury causing muscle cramping (Mostly in the calf area). 32°C is considered too warm for any water exercise slow (Jill E. White, 2010, p. 85). Keeping the water temperature 28-30°C will allow the body to react naturally to achieve the goals of physical fitness without the risk of heat or overheating. The body will be able to stabilize internal temperatures to comfortable levels (Jill E. White, 2010, p. 86). In other words, it is best to avoid the water temperatures of 32°C and

be cautious already of 27°C (Jill E. White, 2010, p. 87).

22-25 °C	Swimming
28-30 °C	Water Fitness
32 °C	Too warm

It is important to begin with large muscle group movements (Glutes, back muscles, quads, and hamstrings) as soon as getting into the water and maintaining some type of movements to keep the heat in the body in order to keep the body from pausing and beginning the cooling process. It is also important to maintain a movement even during the stretching part in order to keep the core temperature from dropping. For example, while doing static stretching in the upper body in the water, the lower body should keep on moving to generate the heat. Each body is different and will respond differently to aquatic exercises, so it is important to listen to own body (Jill E. White, 2010, p. 87).

Table 5.1 Recommended Water Temperature/Aquatic Exercise Association Standards and Guidelines for Aquatic Fitness Programming

Competitive swimming	78-82 F/25.6-27.8 C*
Resistance training	83-86 F/28.3-30 C (minimum range)
Therapy and rehab	90-95 F/32.2-35 C** (low function program—cooler temperatures might be more appropriate for higher intensity programs and specific populations)
Multiple sclerosis	80-84 F/26.7-28.9 C
Parkinson's disease	90-92 F/32.2-33.3 C**** (ideal temperature)
Pregnancy	83-85 F/28.3-29.4 C
Arthritis	83-90 F/28.3-32.2 C***
Older adults	83-86 F/28.3-30 C (moderate to high intensity) 86-88 F/30-31.1 C (low intensity)
Children, fitness	83-86 F/28.3-30 C
Children, swim lessons	84+ F/28.9+ C* (varies with age, class length, and programming; ideal learn-to-swim program is best suited for 84-89 F/28.9-31.7 C when available)
Infant programs (4 and under)	90-93 F/32.2-33.9 C*
Obese	80-86 F/26.5-30 C

Figure 1

(Jill E. White, 2010)

1.3 Health Cautions With Water

As much as water can be healthy for the body, it can still affect it in many other ways through pools, spas, hot tubs, water playgrounds, and marine water when inadequately treated. With poor treatment, infectious pathogens, such as *Cryptosporidium*, can cause gastrointestinal (Disorder in the digestive system), respiratory, skin, ear, eye, and neurological illnesses. For safe water to be safe, there should be proper maintaining of the pH and chlorine levels in order to prevent transmissions of the infectious pathogens in the pool, spa, hot tub, and water playgrounds. As recommended by CDC (Center for Disease Control and Prevention), normal water pH levels in should be around 7.2-7.8, and chlorine at level 3. For personal safety, test strips for pH levels can be bought in some superstores, hardware stores, and pool supply stores. (<https://wwwnc.cdc.gov/travel/yellowbook/2018/the-pre-travel-consulation/food-water-precautions>).

Even though physical exercise in the water reduces risks of diseases, improves quality of life, and most adults can participate safely, there are still health cautions concerning physical exercise in the water. It is recommended to be alert of your own, athlete's, or participant's health status due to the performance of health risk assessments. Each person doing any exercise in the water should complete a health history document, which includes a questionnaire and interview in order to identify any past or present medical conditions that might affect the person's safety in the water program, such as injuries, illnesses, conditions, surgeries, family history, gender, age, tobacco use, use of medical supplements, or blood pressure (Jill E. White,

2010, p. 290). There as well should be a physician's form where the physician gives permission to release the medical records of the patient (Jill E. White, 2010, p. 293).

Limits on participation in aquatic-based programs are hardly ever based of patient or client characteristics, rather on staff and facility capabilities. Often, the same issues limit exercise on land, meaning that a person who is too medically unstable to exercise on land, cannot exercise in the pool.

Absolute Contraindications To Aquatic Rehabilitation:

- Unstable cardiac conditions and vital signs
- Uncontrolled hypertension, seizures, diabetes
- Open infected wounds
- Active infections (Disease transmissions which cause viruses that cause vomiting, exposure of other infectious body liquids)
- Fevers (Especially in warm water pools)
- Ear infections (Severe or chronic)
- Chronic urinary tract infections
- Yeast infections
- Chronic skin diseases
- Those at risk of hyper/hypothermia

Reference: "Aquatic Fitness Professional Manual", Sixth Edition, Jill E. White, 2010" Book

Behavior that can affect the safety of the client, staff, or other patients, phobia of water (Extreme), or fragile medical conditions (Systematic), are additional contraindications to aquatic rehabilitation. For people who fear water, it is not a good idea to be in a pool with the following things: Few handrails and supports, high turbulence from the water, a low staff-to-client ratio, poor lighting, and being in the deep end. To make a person who fears water more comfortable, they should be in a well lit, low-turbulence, shallow

pool with staff that can immediately be available in the water. The atmosphere must be as comfortable as possible for the fearful patient/client.

People with limited chest expansions is another precaution that can limit the participation of water exercise. The hydrostatic pressure makes a compressive force on the chest, limiting chest expansion, thus making breathing difficult. This mostly happens to people with pulmonary diseases, such as influenza and tuberculosis, or with pulmonary problems associated with conditions such as postpolio or spinal cord injuries. Such pressure on the chest increases fear in people who are already anxious about water exercise. Explaining the normal effects of the physical properties of water to patients/clients in advance is strongly advised. Clients with cardiac conditions require special screening and attention, including clearance from the cardiologist or primary physician. Any exercise limitations should as well be verified and followed. Relative risks and benefits of any given intervention must be assessed within the context of the client's situation, preferences, and options, as well as the client being involved in the decision making process and guidelines of informed consent (Lori Thein Brody, 2009, pg.11).

When finding a pool, water temperature and quality must be checked. The National Swimming Pool Foundation makes sure pool chemicals are controlled by someone certified by them or someone with a certain level of training and knowledge. Chemicals clean the pool in order to prevent the transmission of communicable diseases. Chemicals such as chlorine, bromide, and other chloramines that are used to clean the pool, could irritate the skin, dry out the hair, or cause swimsuits to fade. Irritation to any of these chemicals will first be noticed in the eyes. To protect the eyes, wearing goggles is strongly advised. Being in a pool with high chemical content, it is

recommended to always shower before and after getting into the water, including a good soaking of the hair and swimsuit (Melissa Layne, 2015, p.17).

2) General Benefits Of Water Exercises

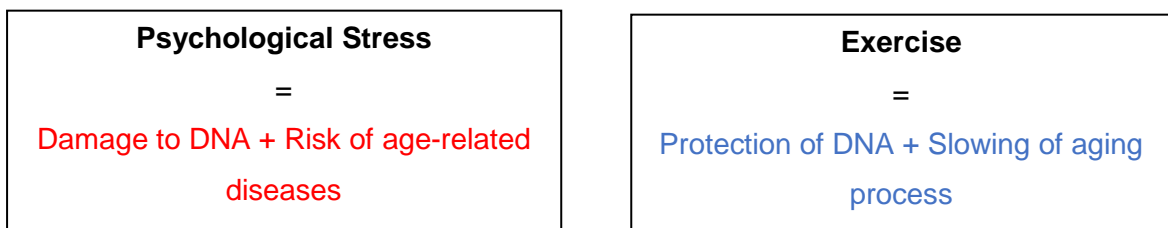
To some people water exercises seem like a low-intensity workout, but due to the water's built-in resistance, it is simple enough to increase the intensity of the workout while working on all the muscles that are harder to work on land. For example, the pressure from the water gives the lungs a good workout, making them work harder than they would have worked on dryland. Some of the famous benefits of water exercise include the building of cardiovascular stamina, strength, flexibility, burning of body fat, improved circulation, and rehabilitation of muscles and joints.

2.1 Psychological Effects

Aside to the physical health benefits of water exercise, there are also psychological benefits. William Wilson, an author of the 1883 "The Swimming Instructor" book, says that "An experienced swimmer, when in the water, may be classed among the happiest of mortals in the happiest of moods, and in the most complete enjoyment of the happiest of exercises". Exercising in the water releases a large amount of endorphin cells, which are responsible for creating those good feelings. Endorphins are released from the deep rhythmic breathing and constant stretching and relaxation of the muscles, making it feel as if a person was doing yoga or meditation. Hearing own breathing, the relaxing noise of water splashes, the release of endorphins, rhythm of the strokes, and being active in the water, makes it

feel like a relaxing meditation and creates the perfect stress relief. Any contact with the water helps loosen up the body and the mind. (<http://www.enjoy-swimming.com/benefits-of-swimming.html>)

Exercise also releases a certain type of stress cells called "Hormesis", which are good for the body and that can even reverse the effects of chronic negative stress in the brain. Other psychological benefits are: Improved self-image, more efficient brain function, increase in one's sense of well-being, slowing of memory loss, and improvement of short-term memory loss. These benefits improve our quality of life and help become happier (Melissa Layne, 2015, p.10).



**Reference: "Water Exercise" by Melissa Layne, 2015, pg.9*

Prominent features of water: Color, shiness, and motion. Blue is the color that humans seem to be drawn to, it is chosen as a favorite color by people around the world (Both women and men), and the color is everywhere from nature to the sky on a sunny day. Depending on the location, water can range in a mixture with other colors such as green, brown, or white (Wallace J. Nichols, 2014, p. 87). It is considered that the color blue is associated with trust, confidence, and dependable strength. For example, big companies such as Facebook, AT&T, Lowe's, Twitter, American Express, HP, IBM, and Walmart use blue as their corporate. Amir Vokshoor, a famous neurosurgeon from Santa Monica, has a theory of the reason why blue produces such positive feelings in humans. He stated that is it primary because of the shades of water and blue skies, alongside the shades of green and earth tones. The color blue is known

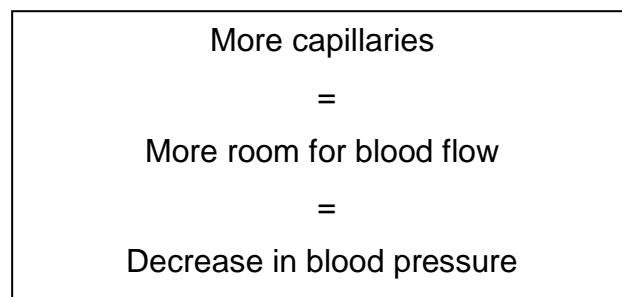
to influence calming, relaxing, and energizing effects that stimulate a positive emotional response. Amir believes that blue's wavelengths releases neurotransmitters associated with feelings of euphoria, joy, reward, and wellness, which are related to the effects of dopamine (Wallace J. Nichols, 2014, p. 89).

"Throughout history, people of all cultures have assumed that environment influences behavior. Now modern science is confirming that our actions, thoughts, and feelings are indeed shaped not just by our genes and neurochemistry, history, and relationships, but also by our surroundings" – Winidred Gallagher, "The Power Of Place" (Wallace J. Nichols, 2014, p. 64)

2.2 Physical Effects

Heart health is improved in all facets through water exercise, also known as cardiovascular or cardiorespiratory fitness (Ability of the heart, lungs, blood vessels to carry oxygen to working muscles). With heart disease being the number one killer of people in the world, many people consider cardiac health important for any fitness program. Through water fitness activities, large muscle groups are used in continuous movements, thus developing cardiovascular fitness. One of the ways to assess cardiovascular health is to monitor resting heart rate, which is one of the indicators of the heart's health. During the progress through workouts, there should be a drop in the resting heart rate, meaning that the heart is becoming more efficient. In other words, the lower the heart rate is, the better the shape the body is in. As the heart gets bigger and stronger, more blood is pumped per stroke, and as a result, the heart doesn't have to pump as often, making less beats per minute at rest. Exercise of any kind also decreases the blood pressure, mainly because of the strengthening of the heart and reduces the plaque lining in the veins and arteries (Melissa Layne, 2015, p.8). The liver also makes

more healthy cholesterol, which is known to remove the unhealthy cholesterol of the artery walls, giving blood more space to move freely through the vessels, thus decreasing the blood pressure. Resistance exercise reduces the blood pressure by prompting the body to create more capillaries. For example, in water exercises, as you push the arms and legs through the water, the size of the muscle fibers slowly increase, and as they slowly increase, more capillaries are made by the body to carry blood to the muscles. With the heart working closely with the lungs, the lung capacity improves and the breathing becomes more efficient, at the same time aiding in the circulation of oxygen and nutrients throughout the body, making it operate more efficiently (Melissa Layne, 2015, p.9).



**Reference: Book "Water Exercise" by Melissa Layne, 2015, pg.9*

Any calorie burning type of exercise increases the chance of changing the body composition. By exercising in the pool, there is an increase in caloric expenditure where more fat cells are burned as a form of energy. The pool and water exercises provide this work by the built-in resistance from the viscosity of the water that makes you push through in every move that is made. Maintaining a calorie-deficit and a healthy eating pattern with the water exercises will promote a positive effect on the body composition, with not only giving a noticeable shift on the body but also increase the ability of most organs to effectively function, experience less stress, and increasing the lifespan and quality of life (Melissa Layne, 2015, p.9).

Water exercises provide musculoskeletal fitness, which is known for muscular endurance and strength. Working on the musculoskeletal system,

it will be easier to perform the activities of daily living such as improved posture, reduced blood pressure, and a low chance of injury on a daily basis. Some of the improvements include: An ease in getting up from the floor or sitting down on a chair (Since the leg muscles will be stronger), doing activities will be easier, walking patterns will become more stable (From the strong muscles around the hip joints), and stronger bones with an increase of their density (Decreasing the risk of osteoporosis, which is a condition of losing bone mass that affects the hips, spine, and wrists). Muscular endurance also increases the body's efficiency of skeletal support which protects the bones and gives the ability to hold the body in a way where a person is less likely to lose balance and fall. There are other muscular improvements provided by exercise. Improvements such as decreased chronic back pain, reduced chances of strains and sprains, lower risk of injury that will help with keeping balance (By stretching the tendons and ligaments), and maintaining muscle mass that slows age-related decline in metabolism (Combination of physical and chemical processes that occur within the body's cells that are necessary for maintaining life) (Melissa Layne, 2015, p.11).

2.3 History Of Healing And Rehabilitation In The Water

With our bodies composed mostly out of water, it is a natural place for healing and rehabilitation. People have been using water for healing and rituals for many centuries, providing a foundation for understanding the current cultural climate of aquatics in rehabilitation, exercise, and medicine. In the early 2400 B.C, water was used for religious and healing purposes, with the same use continuing today. Back in 1500 B.C, water was used to combat fevers, in the Far East it was used for curative purposes, and in early 800 B.C the waters of Bath in England were used for healing purposes.

Some of the first schools of medicine in Greece arose near the bath and springs to recognize the benefits of water as a curative treatment. Developing centers near natural springs, and rivers, the Greeks were the ones to recognize and appreciate the relation between state of mind and physical well-being, documenting the use of hot and cold immersion to treat diseases, muscle spasms, and joint pains (Hippocrates 460-275 B.C) (Lori Thein Brody, 2009, p.4).

3) Water And The Athletic Body

In water fitness, muscular endurance consists of a muscle's ability to contract repeatedly against the resistance exerted by water. Being considered one of the most effective cross training workouts, aqua training decreases the impact on the joints due to the water's buoyancy property. Doing strength and bodyweight movements in the water will drastically improve joint mobility in the hips, spine, and shoulders. It is recommended to add 2-3 aqua sessions a week in a training program (<https://www.mensjournal.com/health-fitness/7-ways-build-muscle-pool-without-swimming/1-push-plate-chest-press>).

3.1 Hydration: Importance Of Water Intake

Bringing a water bottle to the pool is a safety precaution in avoiding dehydration. With warm, humid environments in the indoor and outdoor pools, dehydration does occur, even when it seems impossible. Due to the transfer of body heat into the water (Thermoregulation), it is recommended to drink water whenever needed in order to prevent dehydration. In a pool environ-

ment with high temperatures, like an outdoor pool in the summer, more water intake is needed, especially when exercising for 60 minutes or less (Ann A. Rosenstein, 2006, p. 16)

Among fitness professionals and nutritionists, a person should drink at least eight 8-oz glasses of water a day, making water one of the most important parts of any diet. Coffee, tea, or soda don't count as liquid intake due to their act as a diuretic (Increase in passing urine and loss of water), causing a person to lose more liquid instead. A report from the Food and Nutrition Board in 1945 found that a healthy body needs 1 milliliter of water for every calorie consumed. Since 2000 calories is the advised consumption of calories per day, the recommended amount of eight 8-oz cups of water covers 2,000 calories. Water helps metabolize fats by making it easier for the kidneys and liver to break down and excrete non-essential fats. Without enough water, the liver stores fat instead of breaking down and processing fatty acids. Proper hydration also helps prevent urinary tract infections, making bacteria unable to attach to the bladder lining. But too much water than what the kidneys can handle, may cause intoxication (Ann A. Rosenstein, 2006, p. 235). Too much water makes the electrolytes in the body become diluted, causing physical changes, changes in behavior, or cause brain damage. Urologists recommend that the best way to know if there is enough water in the body, by checking the urine color. Urine that is clear or pale yellow indicates that the body is getting enough water (A. Rosenstein, 2006, p. 236).

It is well known that it's important to drink water before, during, and after workouts. Drinking water regulates body temperature, delivers nutrients and oxygen to cells, removes waste, and prevents injuries, thus making giving negative effects on health when not drinking enough on a daily basis. In hot or humid weather, just losing 1% of water in body sweat can put a person at risk of illness or injury. Under-hydration can also throw off balance important

functions of the body system, thus leading to heart, digestive, nervous system, musculoskeletal system, and endocrine system problems. Having cramps can be another way to identify dehydration, due to the loss of water and electrolytes (Sodium, potassium, magnesium, calcium, and chloride) that support normal muscle contractions

(https://www.google.ru/amp/s/.www.coastalorthteam.com/blog/hydration-why-water-matters-for-preventing-injuries%3fhs_amp=true) . Heat is one of the biggest factors for causing illnesses and dehydration in athletes, especially while exercising. During an exercise, the athlete's body temperature is elevated, making the body start to sweat to cool itself down, thus losing critical electrolytes. Without the replenishing of water and electrolytes, dehydration occurs and the risk of heat illness (Heat stroke) arises. Some signs of heat illness include chills, dark urine, dizziness, dry mouth, headaches, thirst, and weakness. If the heat illness continues, more serious symptoms start to develop: Difficulty breathing, dangerously high body temperatures, muscle cramps, nausea, and tingling of limbs (https://www.stopsportsinjuries.org/stop/stop/prevent_injuries/heat_illness_prevention.aspx)

Proper Hydration:

- Improved circulation
- Reduced high blood pressure
- Regulated body temperature
- Controlled cholesterol levels
- Improved brain function
- Nutrients and oxygen supplied to cells
- Flushed toxins and bacteria from the kidneys, bladder, and gut
 - Proper digestion and absorption of nutrients
 - Moisturized skin
 - Aid in weight management and weight loss

Dehydration:

- Dryness of lips, mouth, tongue
 - Reduced energy/apathy
- Changes in urine (Infrequent urination, small volume of urine, dark urine)
- Decline in mood, strength, coordination, or to inability to make decisions

*Reference: (https://www.google.ru/amp/s/www.coastalorthteam.com/blog/hydration-why-water-matters-for-preventing-injuries%3fhs_amp=true) .

3.2 Building Strength With Water

With a high demand of a full-body exercise, working out in the water is a great way to building strength. Exercising in water is more challenging compared to exercising on dryland due to the resistance from all vectors and angles that the water provides. The biggest factor in water is buoyancy which gives extra support to muscles and joints, compared to running on dryland where is there physical shock on joints. For example, running in water reduces the impact of each footstrike, making it easier on the muscles and joints. This is also helpful in injury prevention and helps those who are injured to continue working out, while at the same time continuing to build strength as they heal (<https://www.google.ru/amp/s/experientcelife.com/article/a-strength-building-water-workout/amp/>). It is proven that through water based exercise, a person builds as much muscle as another person who is in a land-based exercise program (<https://www.google.ru/amp/s/fitness.mercola.com/sites/fitness/archive/2016/02/19/amp/benefits-water-exercises.aspx>)

It has been considered that resistance training in the water can be more effective than lifting heavy metal on dryland. There is an increase in core stability (Including balance), less muscle soreness, better joint mobility (In

hips, spine, shoulders), better muscular strength, more endurance, and increased lean body mass (<https://www.mensjournal.com/health-fitness/7-ways-build-muscle-pool-without-swimming/1-push-plate-chest-press>).

However, due to the low-impact and low gravity of water aerobics, it does little to build strong bones or lean muscle mass efficiently. But by using weights (Such as foam weights) like in some aerobic workouts, does help build muscle mass, especially in the upper body (<https://www.livestrong.com/article/273601-pros-cons-of-water-aerobics>).

Building strength in water also comes from dragging (Travelling) through the water, with every drag increasing on every increase of movement. Dragging exercises include walking, jogging, and running in the water, and are easier to perform when done in place than through traveling through the pool with more intensity. But when first attempting any exercise, it must be done without dragging. Adding pool equipment to the dragging workout can increase the intensity even more, thus requiring to use more muscular strength to push through the water. There are many pool equipments to choose from, such as gloves or noodles, that increase dragging and as a result, build strength (Melissa Layne, 2015, p.12).

3.3 Preventing Injuries In The Water

Exercise injuries tend to happen when starting out a new workout. Any new activity places stress on the joints and cardiovascular system, so before starting any exercise program, it is recommended to see a doctor for a fitness test. Qualified personal trainers can help structure a safe fitness plan that will be based on a set of goals such as weight loss, muscle building, and aerobic fitness (<https://www.verywellfit.com/tips-for-injury-prevention-during-exercise-3120450>). After getting a clearance, a doctor or a specialist will help set up a guideline on how often/long an aquatic activity must be

performed. Exercise guidelines include the key aspects of exercise such as frequency, intensity, and duration, and usually provided by sports medicine professionals.

It is recommended to exercise overall 3-5 times per week, including doing easy everyday activities, such as walking up the stairs instead of using the elevator, on all the other days of the week. When starting a new exercise, it is suggested to start at a lower intensity, for 15-20 minutes. With the process called "Progressive overload", a workout can either be made more intense or more longer each week. For example, while the body is adjusting to the new exercise, there can be an increase in intensity while maintaining the same duration, or the opposite, where there can be an increase in duration while maintaining the lower intensity (Melissa Layne, 2015, p.11). With progressive overload, it is important to have rest days between exercise sessions in order for muscles and heart to rest and recover, ready to perform again in 48 hours after the last program. Only in the midst of progressing through the exercise program, less time will be needed for recovery, due to the muscles being adapted to the exercises and performing more efficiently. Not only does slow and safe progression minimize the risk of injury, but also affects the psychological factor, where this is a release of endorphins, which are the chemical messengers that make it feel great after a workout (Melissa Layne, 2015, p.12).

The pool environment is the other factor concerning injury prevention and safety. Many injuries of water fitness programs happen outside of the water on the pool deck. Before making a pool membership, it is advised to research the key safety indicators of the pool overall and the environment. There should be non-slip aids on deck and surfaces for entering the pool, such as non-slip stairs and stable handrails. For beginner swimmers or those who feel uncomfortable in the water, should look for facilities with lifeguards or an on-duty lifeguard that will be there during the hours of the practice (Layne, 2015, p.16).

Pool Safety Indicators:

- Non-slip traction aids (Deck & entrance to pool)
- Non-slip surface of deck
- Stable handrail on stairs to the pool
- Mechanical pool chair to get into the water
- Lifeguards
- Lifesaving devices
- Closed skimmer baskets (On the sides of pool that collect floating debris)
- Proper working lights
- Working telephone in office
- Clean pool (Free of debris)
- Having own water bottle (To avoid dehydration)

**Reference: "Water Exercise" book by Melissa Layne, 2015, pg.16*

4) Common Exercises In The Water

Going into the water, the relaxation from it eases the mind, strengthens the body, and keeps the body cool even during exercise, at the same time making the body feel weightless. With the support, grace, and fluidity, in each movement, the natural phenomenon of the water allows muscles, joints, and ligaments to move freely and comfortably without the pounding, straining, or jarring.

Exercising in the water, the muscles are forced to work harder than on dryland, making the results be seen faster, especially in strength and increased muscle tone (Jane Katz, 1996, p.2). With the help of water, the muscles will be supported, healed, and relaxed after being strained or tightened by other activities. It is well known that for quicker recovery and for getting back to former fitness level in sports injuries, water fitness workouts will benefit (Jane Katz, 1996, p.3).

Any water exercise is considered to be an aerobic exercise. Aerobic exercises benefit the cardiovascular system, which carries blood to the working muscles, giving them oxygen from the air that was breathed in, thus eliminating carbon dioxide and other waste products from the body. With strong and efficient heart and lungs, the aerobic capacity becomes greater, giving less strain on the heart, more ability to perform work, cope with stress, and giving a greater feeling of well-being. Without a strong cardiovascular system, a person cannot be fully fit, even having big biceps. Improving the aerobic capacity is one of the most important goals in being physically fit (Jane Katz, 1996, p.4).

Water exercises target muscles throughout the body and heart, decrease the resting heart rate, increase the muscle tone, increase the cardiovascular endurance, and decreases blood counts, which will be seen over-time. Improving the fitness levels, the length of workouts should also slowly increase. Adding water exercise to a fitness program can decrease over-training in the activities involving great impact, lowers the risk of getting bored with exercises, and helps prevent the body from hitting a plateau. Normal water exercise programs are different from rehabilitation exercises, where as the main goal of water exercise program is to increase the fitness level while maintaining safety within the parameters of a specific condition (Melissa Layne, 2015, p.195).

4.1 Hydrotherapy

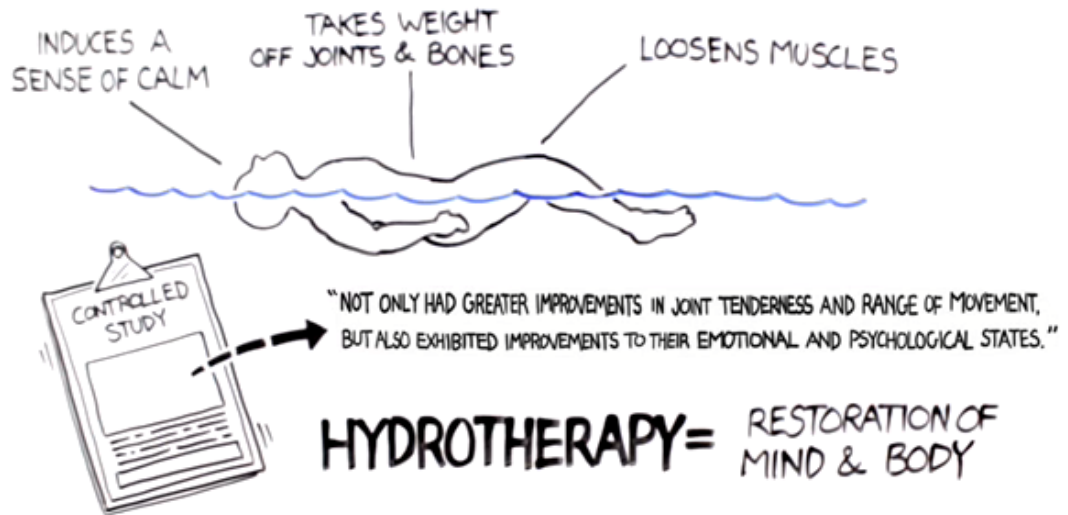
Also known as “Hydrotherapy” and “Water cure”, hydrotherapy involves the use of water for pain relief and treatment and is part of alternative medicine. It has approaches and therapeutic methods, taking advantage of the physical properties (Temperature and pressure) for therapeutic purposes in order to stimulate blood circulation or treat the symptoms of some diseases. Hy-

drotherapy is done with the help of water jets, underwater massages, mineral baths, and whirlpool baths (<https://en.m.wikipedia.org/wiki/hydrotherapy>). Underwater exercises prescribed by therapists, help their patients strengthen weakened muscles, help relax torn and strained muscles, and improve muscle function for those who are recovering from a stroke or injury (Jane Katz, 1996, p.2).

Hydrotherapy is also known to bring relief to the muscles, ligaments, and chronic conditions with the help of hot and icy water usage. The icy water therapy is called “Cryotherapy”. Cold water is used by hydrotherapists to reduce swelling caused by strains and sprains, and to decrease fevers. Cryotherapy is where ice is used to reduce tissue swelling, to decrease pain, to relax, and increase circulation to an affected area. Cold reduces swelling to decrease internal tissue pressure, thus reducing the amount of fluids outside the injured tissues, making blood circulate more freely (Jane Katz, 1996, p.130). Coldness not only reduces pain by causing numbness, but also causes internal biochemical changes to help healing in tissue. It is recommended that ice needs to be applied to an injury for 20 minutes, then left for an hour without the cold to have the tissues return to normal. Ice is also used on non-visible swellings to open blood channels, but this is often used as a preventive measure by athletes participating in vigorous sports.

Heat increases blood circulation from warm applications to cause internal tissue under the skin to bring more blood, thus increasing oxygenation in the affected area and getting rid of waste products such as lactic acid, at the same time reducing pain. Sensory nerve endings carry any warmth given to the brain and spinal cord as a relaxant, thus with the relaxation acting as a pain reducer. Heat treatment can be used in mud, salt, paraffin wax, spas,

saunas, baths, and moist-heat therapy. Spas treat sprains, relief neuritis, muscle fatigue, and arthritis (Jane Katz, 1996, p.131).



See R. D. Berfield, et al. "The effects of hydrotherapy on anxiety, pain, neuroendocrine responses." Biologic Research for Nursing 12, no 1 (July 2010): <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3904302/>

Figure 2

(<https://www.youtube.com/watch?v=IGEvuoWmt8>)

4.2 Water Fitness

The advantage of water fitness exercises that it offers vertical exercises that don't require anyone to be a strong swimmer. The only thing that the individual must be able to do is be comfortable lifting one foot off the pool floor. If uncomfortable or during exercises that involve lifting both feet of the floor, the individual can go to the side of the pool and hold the wall while performing the exercise. It is recommended to search for a pool that has different depths, where there'll be a variation in working both shallow

and deep ends, giving a chance to change impacts and have more availability to a variety of other water exercises (Melissa Layne, 2015, p.16).

The key elements of a water fitness program should be the same as with any other workout: Warm-up, main set, and a cool-down, with the workout time of 20-45 minutes. A warm-up should be 5 minutes long, where the muscles are being prepared for work by slow muscle loosening and stretching, with the elevation of the heart rate. The warm-up allows the body to adjust from a land environment to the water. The main set, which is the aerobic part of the workout, should be around 20-30 minutes of continuous movements in the water, in order to exercise all body areas, and at the same time rising the pulse up to it's heart target rate. The cool-down ends the workout with about 5 minutes of easy stretching and relaxation exercises to slowly make the body return to it's warm-up state and heart rate that it started with (Jane Katz, 1996, p.4).

As with any other fitness program, dryland or in water, all of the components of health-related fitness should be addressed: Cardiovascular endurance, muscular endurance, muscular strength, and flexibility. Basic water exercise routines should also incorporate movements of all major muscles, at intensities that will challenge the heart, and bring flexibility that will come during contraction of opposing muscles. Warm-up in water fitness can be a 3-5 minute shallow-walk or jogging, with the addition of using the upper body by moving the arms just like on dryland. A good indicator that it is time to move to the main workout, is when the feeling of being chill disappears and the joints feeling more free to move in larger range of motions. During the warm-up, equipment shouldn't be used due to the chance of it increasing the movement of the working limb before the muscles are prepared to work harder. During the warm-up, the hands should move like they are slicing the water, not pushing it, because only then as the body gets warmer,

hands can slowly start changing some moves to a push (Melissa Layne, 2015, p.197).

4.3 Swimming

Swimming is ranked third place in the top ten most popular sports around the world. Studies have shown that starting from 1990, swimming has been increasing popularity each year. In 2008 it was ranked number two in the top ten, then moving back to third place. Some swimming experts believe that swimming's ranking went to second place after Michael Phelps's participation in the 2008 summer Olympics http://www.aquatic-sintl.com/facilities/management-operators/study-shows-swimming-popularity-growing_o

There are countless beneficial things that swimming does to a person's health when performing it. The first health benefit from swimming is the increased muscle tone and strength. http://swimming.about.com/od/swimworkouts/a/swim_benefit.htm. Every kick and arm stroke in the water becomes a resistance exercise, which is considered to be a great exercise to build muscle tone and strength. Second health benefit is flexibility improvement. Unlike going to the gym and working at one body part at a time, swimming offers the work of all body parts at the same time, making joints and ligaments stay loose and flexible. The arms are moving, the hips are in sync with the legs, the head and spine move side to side, plus the stretches from head to toe. It is also beneficial to do some gentle stretches after working out, in order to practice and add some more flexibility. Weight control is another health benefit coming from swimming. But the number of calories burned depends on the physiology and the intensity of the workout. There is a calculation which states how much calories each stroke burns every 10 minutes. For example, breaststroke will burn 60 calories in 10 minutes,

backstroke burns 80, freestyle will burn 100, and butterfly 150. In fact, recent studies have shown that swimming is now recognized as one of the biggest calorie burners around, and that it is a great way to keep weight under control. <http://poolandpatio.about.com/od/outdoorliving/tp/Swimming-Popularity.htm>

The two most important health benefits from swimming would be the improvements of the cardiovascular and respiratory systems. Since swimming is an aerobic exercise, it strengthens the heart by helping it become larger, making it more efficient in pumping blood throughout the body, decreases blood pressure, and lowers the heart rate. <http://www.webmd.com/fitness-exercise/features/fitness-basics-swimming-is-for-everyone#1> The American Heart Association states that 30 minutes of exercise per day, such as swimming, reduces heart diseases. The respiratory system benefits from swimming due to the increase of the diaphragm, which leads to overall respiration improvement. During swimming, there is an increase of capillaries that are crucial in the supply of oxygen to the bloodstream. The combination of cardiovascular and respiratory system improvement leads to improved oxygen uptake, which makes a swimmer have a normal healthy breathing pattern during training, competitions, and outside of the pool.

<http://health.howstuffworks.com/wellness/aging/retirement/10-health-benefits-of-swimming1.htm>

4.4 Rehabilitation

Through water's viscosity, the injured joint and surrounding muscles develop strength and endurance. It provides balanced resistance no matter what direction a limb is moved. To be clear, balanced resistance will prevent one muscle from getting stronger than the other instead of causing an uneven pulling on a tendon, which can cause inflammation (Body part becoming reddened, swollen, hot, painful) or tendinitis (Inflammation of a tendon) (Melissa Layne, 2015, pg.7).

Buoyancy is considered the primary component of rehabilitation after injury or surgery due to its ways of aiding flexibility – the range of motion around a joint (Melissa Layne, 2015, p.5). Water providing buoyancy and reduction of gravitational force, makes it easier for the person exercising to move their limbs more freely and without any pain to the water's surface. Any rehabilitation in the water is best done in the deep end where buoyancy is the greatest, where the gravitational pull on the injured body part is eliminated, thus allowing the joint to float freely towards the surface of the water (Melissa Layne, 2015, p.5).

Due to the forgiving environment of the pool, its water cushions support the body while reducing the impact on the bones and joints, allowing a way to get in shape, stay in shape, or rehabilitate an injured part of the body. Aquatic activity remains popular by offering a way to exercise regardless of what kind of shape a person is in (Melissa Layne, 2015, p.3). Using water exercise, those who are in the midst of rehabilitation can see an increase in strength after a decrease in size, mobility, or strength in the injured limb, joint, and muscle caused from the injury (Melissa Layne, 2015, p.10).

The range of motion, also known as flexibility, is closely related to muscular fitness. Flexibility is mostly associated with stretching but is aided by the movement of muscles through a full range of motion without holding a stretch. In other words, you can still work on flexibility by just moving a muscle in a full range of motion without holding a stretch. For example, if a person stands in chest-deep water with their arms by the sides without thinking about them, the arms will start rising to the surface of the water by themselves from the help of buoyancy (Melissa Layne, 2015, p.10). This makes the pool a great place for the increasement of a joint's range of motion after an injury or surgery without outside pressure or force on the joints.

Advantages are profound when turning to water as the only available option while recovering from injury. For example, with water exercise, athletes have a significant ability to continue a cardiovascular training program despite an injury. Sometimes an injury or a surgery limits joint loads, so for those who are trying to recover, are the ideal candidates for aquatic exercise. Making a decision about the benefits of an aquatic program, it is considered useful to see the needs and goals of the client rather than a specific diagnostic category. Some clients, like those with sclerosis (Disabling disease of the brain and central nervous system), or those who had back surgery, can participate in aquatic exercise (Lori Thein Brody, 2009, p. 9). It is important to know the individual differences. For example, some people with knee arthritis will do well in aquatic exercise programs, but some people won't.

Due to the lack of formal training in aquatic rehabilitation, the opportunities for the research of efficacy of aquatic physical therapy and rehabilitation is low. From the early 20th century, aquatic rehabilitation made great strides and advances, but there is still a lot to be done to improve and help the therapeutic procedure. This can only be done with the continued effort of clinical and research by healthcare professionals that believe in the positive benefits of adding aquatic rehabilitation to a therapeutic treatment or to a wellness program (Lori Thein Brody, 2009, p. 9).

4.5 Theory: Why Aquatic Heart Rates May Be Lower Than Heart Rates On Dryland

Unlike exercising on dryland, the heart rate reduces when exercising in the water. On an average, the heart rate is 17 beats per minutes lower in the water than on land, meaning that the body is working harder than what the heart rate is informing (<https://www.sportsrec.com/331379-water-strength-training.html>). Other factors regarding lower heart rates in the water

compared to dryland: Water cools the body with less effort than air (Meaning less work for the heart, resulting in lower heart rate), water reduces the effect of gravity on the body (Blood flows from below the heart back up to the heart with less effort due to low gravity from the water), and water is a compressor on all the systems of the body, especially the vascular system by causing a smaller venous load to the heart than land exercises (The heart has to work less to return blood from limbs)(Jill E. White, 2010, p. 85).

5) Physical Laws And Properties Of Water

Our bodies were designed to be active, moving machines. Motion for the human body is in the form of physical exercise and is essential to normal functioning and health. In water exercises, basically three objects move: Entire body, water, and limbs. In water exercises, force (Resistance) is needed to move, change a movement, start a jumping jack, to stop, and to move a limb (From the state of rest). The size of the limbs and hands moving against the water's resistance affects the intensity of the workout. Meaning that the bigger the size of the hand/limb, the bigger intensity will be. The smaller a hand/limb is, the smaller the intensity. Compared to water, air doesn't offer much resistance unless the speed of the movement is very fast since the only resistance happens from the movement being done against the gravity on the ground (Jill E. White, 2010, p. 99)

Hand positioning is an important factor during water exercise. As mentioned earlier, the size of the surface area of the hand and shape determine how much water the hand pulls and how much resistance is created. A hand closed in a fist or a hand going sideways through water causes minimal resistance. A hand that is open (Like in most swimming strokes) with relaxed fingers is the most effective for pulling water. Understanding the importance of hand positioning in the water will increase the effectiveness of the

workout. The only less demanding hand positions are useful for people with weak upper bodies, weak core stabilizers, shoulder/joint problems, arthritis, and other musculoskeletal conditions that could cause problems when adding resistance (Jill E. White, 2010, p. 103)

To be stable in the water, the center of gravity (Hip/waist area) and the center of buoyancy (Chest area) should be vertically aligned. If not, the body will roll and turn until balance is found (Jill E. White, 2010, p. 110). Moving the body or limbs when trying to find balance alters the vertical alignment. Which is why more care should be given when planning transitions and traveling movements, since the body should be kept in alignment and the individual performing the task must know how to properly realign the body between movements. Alignment is an important factor for increasing the effectiveness of the workout and lowers the risk of injury (Especially in vertical suspended exercises).

The three main properties of water are buoyancy, hydrostatic pressure, and viscosity. They make aquatic exercises safe, effective, well-balanced, and low-impact, which is especially needed for those who want to increase their overall fitness and those who are seeking rehabilitation after surgery or injury (Melissa Layne, 2015, p.3)

5.1 Buoyancy

Buoyancy – Upward pressure from the water, also known as the opposite of gravity's downward pull and one of the greatest advantages of working in the pool. One way to observe the effect of buoyancy is to place an object, such as a ball, to the bottom of the pool, release it, and watch it go up to the surface of the water. Buoyancy makes aquatic exercise a low-impact activity due to the feeling of weightlessness that is felt in the water and the decrease of the compressive forces experienced by the joints and spine (Melissa Layne, 2015, p.4). Buoyancy is beneficial for water exercises due

to it decreasing the effects of gravity and reducing weight of the compression of joints. The properties of buoyancy allow people who can't exercise on land (Bearing their full weight), exercise comfortably and with strength in the water (Jill E. White, 2010, p. 109)

The depth of the water defines the amount of benefits provided by buoyancy for exercise. In other words, the level that the water is at on the body during exercise is the level of impact that the joints will get. Standing with the water reaching to your belly button will reduce the impact to your joints by 50%, although it may not be comfortable enough to exercise for some people. Positioning yourself mid-chest/nipple level, you reduce the impact by 75%, which is one of the most comfortable positions for most people who don't possess strong swimming skills. To make a 90% impact, the depth of the water must reach to the collar bone, making it more difficult to maintain one's balance. This is mostly used by people who are fit and for cross training where the balance is challenged due to the forced contraction of the core muscles in the torso (Melissa Layne, 2015, p.4). With all the varieties of the water depths, the chest level is considered the common depth for successful water exercise (Melissa Layne, 2015, p.5)

Buoyancy = Loss of weight of a submerged body equals the weight of the fluid displaced by the body. The buoyant property states that there are 2 opposing forces when standing in water: *Downward vertical force of gravity* and *upward vertical force of buoyancy*. In other words, buoyancy's magnitude depends on the size and density of the submerged body. For example, a smaller muscular person will displace a small amount of water, meaning that if the weight of the body is less than the weight of the displaced water, then the body floats. On the opposite hand, if the weight of the body is more than the water displaced, the body sinks. Buoyancy also varies from the body size, density, and lung capacity (Jill E. White, 2010, p. 108)

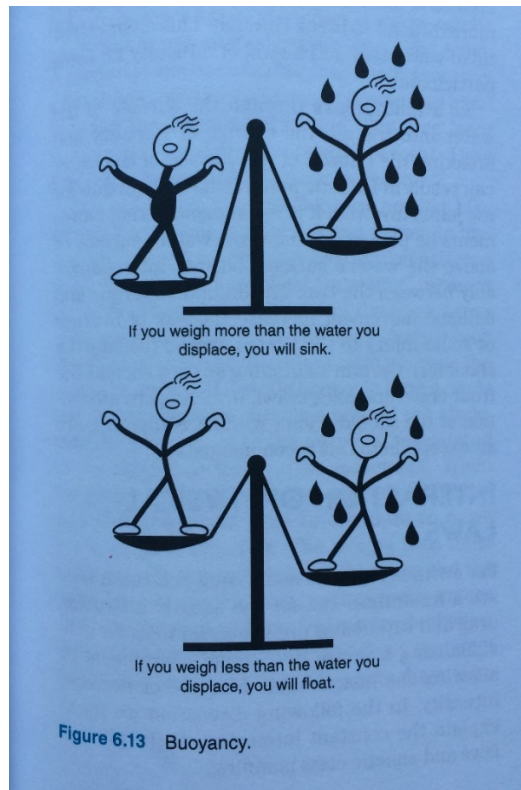


Figure 3

(Jill E. White, 2010)

More work is done on land, due to gravity assistance or resistance movements. In water, it is buoyancy, due to the vertically upward force. There are 3 buoyancy movements: *Buoyancy assisted* (Movements that are done toward the surface of pool, where it easily brings the body up), *Buoyancy resistance* (Happens when an object moves towards the pool bottom, giving extra resistance), and *Buoyancy support* (The floating of an object on the surface of the water). Equipment plays a big role in the buoyancy effect. More work is done against water's resistance than to the buoyancy when the body moves in the water without equipment. With equipment (Such as paddles, leg trainers, gloves, hand bars, dumbbells, ankle weights, balls, belts) buoyancy and gravity become more involved and affect the use of muscle (Jill E. White, 2010)

5.3 Viscosity

Through water's viscosity, you develop muscular fitness. The water molecules provide resistance in every direction, from which all opposing muscle groups start working at the same time. This is caused from the water molecules sticking to each other, creating exert muscle force that is 12-15 times greater than the muscular force needed when moving in the air. This type of resistance provides a stabilizing effect by keeping the body upright, making water a safe environment for people with conditions affecting balance (Melissa Layne, 2015, p.5). There is no danger of falling and breaking a bone if the balance is lost because the water supports the body.

The water molecules also have a property called "Adhesion", which is known to have them stick to other things in the water such as pool noodles, clothing, webbed gloves, and skin. Adjusting factors like the position in which you hold the pool noodle (Horizontally or vertical) or what clothes you're working out in, will determine the intensity of your workout. For example, wearing baggy clothing will create more surface area which will make it harder to move. A tight swimsuit will have less surface area, making it harder for molecules to stick to the skin, will create an easier workout (Melissa Layne, 2015, p.6).

5.4 Thermoregulation

Thermoregulation – Property of the body that increases your comfort level during exercise in the water. Exercising in the water that is cooler than the human body, you can regulate your body temperature by transferring body heat to the water than through sweating. With the temperatures of 25-28°C at a climate-controlled pool, the body can regulate itself by passing heat to the water molecules. As aging occurs, thermoregulation becomes

more important due to a progressive decline in the ability to perspire (Give out sweat through the skin pores).

To raise the temperature of the body, the water requires a large amount of heat, which is caused from the breakage of hydrogen bonds in the water molecules, requiring a large amount of energy to be transferred to the water for that breakage to happen. For example, a crowded pool will always be warmer than an empty one because in a pool full of people, body heat is passed to the cooler surroundings (Melissa Layne, 2015, p.7). This property is helpful in decreasing spasticity (Constant contraction of certain muscle causing stiffness or tightness and interfering with normal movement). It can only work in water that is warmer than 29°C due to the warmer water decreasing the body's ability to thermoregulate, making it helpful to decrease spasticity because of the muscles being warm (Melissa Layne, 2015, p.8).

6) Aim And Research Of Thesis

The aim of this thesis was to find out what happens to our bodies and mind when we perform physical activity in the water and just being in the water, also to introduce to other sport coaches the overlooked benefits that water and water exercises can give to their athletes (Such as rehabilitation and training) all outside the gym and dryland. In the process of reading this thesis, I want the reader to get inspired to try out water exercises, learn something new about water, and change their minds about water and water exercises.

For researching, the methods used for writing this thesis were literature books on aqua fitness programs, internet researches, and a questionnaire for people who swam and worked at the pool. The aquatic fitness books

covered the basics of water exercise in the water, with the support of research found on the internet. The questionnaire was part of the research just to see what people who work in the aquatics field found beneficial for themselves and their clients in water exercise. It was supposed to show what has helped people the most so that the reader can see if their hypothesis was right or wrong on what water exercise can do to the human body based on their knowledge of this topic. The main research came from the literature where a deeper understanding of water exercise and its connection to the physical and mental states.

7) Research Methods: How Did Physical Activity In The Water Benefit You/Your Clients? (Poll)

7.1 The Target Group

To research the ways how physical activity in the water could benefit, my target group were individuals who were associated with water for a long time, those who just swim for leisure, who were going through rehabilitation after surgery, or who just started to exercise in the water. With the collected info I got 3 aqua fitness instructors, 6 swimming coaches, and 15 swimmers who participated in the questionnaire, making it 24 people in total. There

wasn't a specific gender of which I wanted to take more notice of because I was more interested to see the benefits of how water worked with everyone.

7.2 Study Design

The entire thesis process was done during my work placement at a pool (JCC Denver) located in Colorado, U.S.A. While researching and studying how physical activity affects our bodies, I had the chance to witness many different aquatic programs and swimming lessons, and talk to people about water, how they feel being in the water, and how much exercising in the water has helped them. Hearing different types of stories and ways the water has helped, I decided to see what is the biggest benefit that physical activity in the water has brought to the people coming to this pool and the people who work with them (Swimming coaches and aqua fitness instructors). I created a small questionnaire asking what kind of benefits did physical activity in the water bring to the person being asked or how did physical activity benefit an instructors' clients. There were 3 options of the benefits: Changed view on water and water exercise, got stronger (Fitness), and felt healthier and happier (Mental). People were asked to choose the option that worked out the best for them/their clients, and it turned out that choosing just one wasn't enough, because all the three options applied to them. While collecting data, my hypothesis was that mostly everyone will choose the fitness option since the topic has to do with being physically active, especially with working out in the water that naturally gives resistance and works on all the muscle groups.

7.3 Measurements/Data Collection

Measurements were made based on the two main benefit areas of water exercise such as feeling happier (Mental) and getting stronger (Fitness), with the additional option of having a changed view of being in the water

and of water exercises overall. I specifically designed the questionnaire without adding the option "All of the above" because I wanted to precisely see what has benefited people the most. Data was collected for 3 days straight in the middle of March 2019. The questionnaire first went around starting at the aquatics office, then to the pool members, and ending with people outside the aquatics department. I went around to the people I knew were associated with water exercise, those who swam a lot in the pool, and those who were in water fitness programs for specific health promotions. Some of the questioned individuals had a hard time deciding which exact option they want to choose because water exercise brought all the listed benefits, some insisted that they will take part in the questionnaire only if they get to choose more than one option, and some just wrote their names under every benefit listed. After collecting all the data, my hypothesis was incorrect. My guess was that more people would answer "Fitness", but in this collected data, it was more of the mental part.

7.4 Statistical Method

To find out statistics for the current question, I first thought of a hypothesis that would prove that fitness is the biggest benefit from swimming but at the same time I was aiming that something would prove it wrong. Then there was an overall count of names that participated in the questionnaire, a name count under every option, and ending with a comparison of the numbers of names for each option. Based on the methods, this was the best

way to find out what the majority of the members think of water and how it helped.

8) Results

The results for the current question were taken 3 days after the questionnaire started going around. First calculations were based on how many people participated overall. With a few people voting more than once, the calculations had to be made very carefully in order to reduce the risk of counting someone twice, so the names of the people who voted twice were put on a separate list and counted later after those who voted once. After calculating how many people have participated, there was a data collection on how many people voted for each option of benefits. At the end, to find the final results of this questionnaire and to the question of how water exercise can benefit, a comparison was made between the 3 voting options and the option with the highest amount of votes was the result of the given question. Figure 5 has shown that the biggest benefit that water exercise has given to the particular group of people asked was the mental side.

Based on the research found from literature and own opinion, the reason why so many people voted for the mental side is because the moment that they remembered how water exercise helped them or their clients, they felt happiest or remembered seeing their clients happier. Chapter 2.1 of this thesis states that water eases up the mind and body, while water exercise releases a large amount of endorphin cells that are responsible for causing an overall feeling of happiness (<http://www.enjoy-swimming.com/benefits-of-swimming.html>).

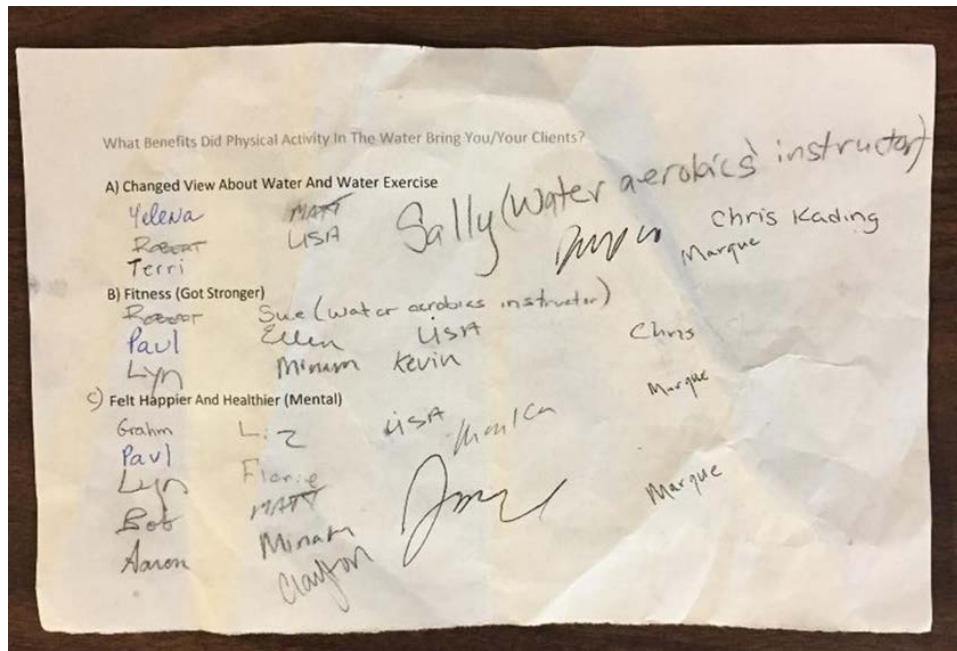


Figure 5 (Questionnaire for the research of how water fitness benefited the person being asked)

Benefit	Number of votes
Changed View Of Water	10
Fitness	10
Mental	14

- Number of people voted: 24

Aqua Fitness Instructors	Swimming Coaches	Swimmers
3	6	15

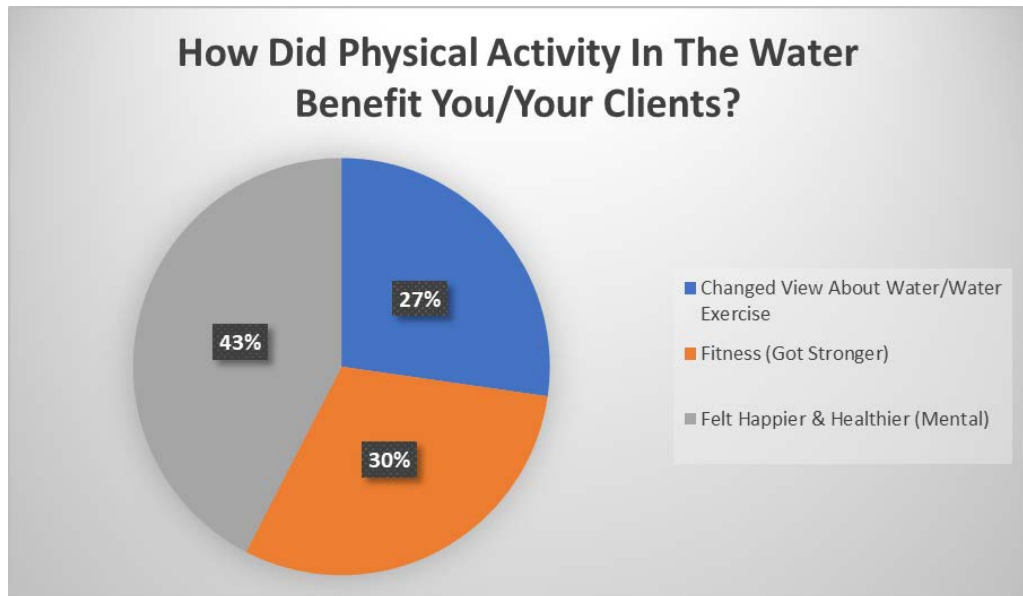


Figure 6 (Pie chart of the collected data from the given questionnaire)

Discussion

The results in the study of physical activity in the water and what it does to the human body brought new knowledge of the power of water. Learning about water itself, the benefits, and the properties, it turns out that many things happen to our body when we place it into the water and start moving in it. Things such as loss of gravity, low-impact rehabilitation, strength building, health improvement, and lower heart rates during exercise, is something that can be easily obtained outside the gym and dryland. Unfortunately, the effects of physical activity in the water is overlooked by coaches of other sports and even swimming coaches. People usually see anything that has to do with water as one of their phobias, something where drowning can occur, a place where mostly elderly people stay in shape, or overall a low-intensity activity. With proper knowledge of water and what it does to our bodies, physical activity in the water will be seen as something to recover with, build strength, reduce stress, and something to promote a healthy life with.

Furthermore, on the basis of the results, physical activity in the water can and should be done by everyone, and it will always bring positive health results both physically and mentally no matter what condition or age a person is at. Coaches of any sport should study more about working out in the water at the pool to bring variety to their practices, especially with the properties of water that could give more benefits to a workout and the training of their athletes than any dryland training would. In my opinion coaches don't know that their athletes can still build muscle moving through water's resistance factor (Melissa Layne, 2015, p.12) or that water exercises can build even more muscle than exercising on dryland could ever do

(<https://www.google.ru/amp/s/fitness.mercola.com/sites/fitness/archive/2016/02/19/amp/benefits-water-exercises.aspx>) . I believe that by adding water exercise to training programs will also benefit athletes in the mental side by increasing better self-image. Chapter 2.1 explains how exercising in the water develops happy feelings which are linked to a better self-image (Melissa Layne, 2015, p.10). Positive feelings and self-images are important factors for an athlete to have in order to perform better due to the fact that performance depends greatly on psychology. To develop this concept, water exercises and programs should be taught in sport coaching trainings for future coaches of any sport to have an idea of what physical activity in the

Suggestions For Non-Water Sport Coaches

(Adding Water Exercise To A Training Program):

- Recommended amount of aqua sessions is 2-3 aqua sessions a week in a training program
(<https://www.mensjournal.com/health-fitness/7-ways-build-muscle-pool-without-swimming/1-push-plate-chest-press>)
- Begin any new water exercise program in slow intensity
(Melissa Layne, 2015, p.11)
- Athletes should ALWAYS stay hydrated at the pool, especially if the trainings occur on hot days
(Ann A. Rosenstein, 2006, p. 16)

water does and is. This way a coach includes a water program to their practices and gives a variety in trainings.

Further research on how physical activity in the water affects the body is still highly recommended. With all the research done mostly on the physical part, one suggestion would be to include more research on the psychology effects of exercising in the water. How do people feel after adding a water fitness program to their workout? Do athletes become more concentrated in competitions after working out in the water the day before? Does stress-management improve from the yoga effect that comes from working out in the water? Many people don't know that it's not only the physical aspects that water exercise can give, but also psychological due to the release of endorphins, the yoga-like effect, and the anti-gravity that makes it feel like nothing is pulling the body down.

One of the most interesting things findings that I've encountered during the process of this thesis was how water and exercising in the water affects our psychology. As a person who grew up in the water, I never really went deep into thinking why there is this feeling of being refreshed and happy after coming out of the pool and practices. Turns out being in the water affects our psychology more than we think. It is interesting to think that while we swim or just move in the water, we release a large amount of happy cells called endorphins that cause that post-swimming feeling of happiness, that the body eases up in mind once in contact with water, or that being in the water has the same effect as yoga or meditation (<http://www.enjoy-swimming.com/benefits-of-swimming.html>). More information can be found in chapter 2.1 of the thesis. After researching how water and water exercise affects our psychology, I developed a different view on water and swimming now that I know what happens, and it is one of the goals for the reader to develop the same outlook after reading this thesis.

In conclusion, the answers to what physical activity in the water does to the body. It turns out there are many things that were overlooked about being physical in the water and water itself. It is now known that exercising in the water at the pool affects our psychology, our bodies can regulate the temperature of the water, the water pushes out lactic acid through the bloodstream and into the kidneys, and that water gives a yoga-like effect. During the thesis process it was a pleasure to share the research that I've collected with other coaches, my swimmers' parents, and clients at the pool of my work placement, and surprise them with the facts about the water and what happens to our bodies when we exercise in it. The questionnaire in chapter 6 gave out an unexpected result of showing that the mental part was the greatest benefit that physical activity gave in the water. As anyone else would think, strength and fitness would be the top benefits of anything physical, but in this case it turned out to be the opposite.

Evaluating my own learning, I would say that the hours and days were worth spending on reading and researching about this topic. As a swimming coach, everything that I learned is going to be very useful to keep in mind and to share with my swimmers. This will show my interest on this particular topic of what happens to our bodies when we exercise in the water and the structure of water in which my practices are taken place in. Adding on, I also evaluate my learning by how people react to the knowledge that I share with them about this thesis topic. I can tell this learning was a success when I can confidently explain to a client or a swimmer about what is happening to their bodies in the midst of their exercise, and them asking for a copy of this thesis due to the interest of finding out more about the physical activity in the water and the human body.

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