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Comparing and Contrasting the Benefits of Aquatic Exercise
with Other Forms of Exercise for the Elderly Population

Katie Shew

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INTRODUCTION

Opening/Background

As humans age, there are certain biological processes that are unavoidable. However, there are also some biological processes that may be avoidable or slowed through a healthy lifestyle. The following is a list of some common problems that can occur with aging.^{1(p.11)}

- | | | |
|----------------------|--------------------|----------------------|
| - Arthritis | - Diabetes | - Obesity |
| - Back problems | - Heart conditions | - Osteoporosis |
| - Chronic pain | - High blood | - Poor muscle |
| - Decreased lung | pressure | strength |
| capacity | - High blood sugar | - Senility |
| - Decreased range of | - High cholesterol | - Stiffness |
| motion | - Insomnia | - Stress and tension |
| - Depression | - Low energy | |

There are five components of physical fitness: aerobic fitness, muscle strength, muscle endurance, flexibility, and body composition. Without all five of these, a person is much more likely to lead an unhealthy lifestyle and possibly develop one or more of the common problems listed above.¹

In order for older adults to stay healthy, both physical activity and exercise should be part of a normal routine. Physical activity is anything during normal daily activities that keeps the body moving. Exercise is something that is planned ahead of time solely for the purpose of getting a workout. Because regular exercise and physical activity keep older individuals physically strong, it allows them to continue to be independent for as long as possible. Research

shows that regular activity can prevent or delay diseases or disabilities such as arthritis, heart disease, and diabetes. It can also help with blood pressure and imbalances in gait. Being active promotes not only physical strength, but also promotes mental health. It can aid in stress management, increasing mood, decreasing depression, and improving brain functions.²

There are many forms of exercise such as walking or jogging, lifting weights, dancing, cycling, yoga, and many more. One in particular that has been promoted for the elderly and older adults is aquatic exercise, which provides numerous benefits that cannot be achieved through exercising outside of the water. These benefits will be discussed in much detail later on, but some of them include managing pain in joints with arthritis, decreasing osteoarthritis pain, and decreasing impact that can cause joint and muscle pain.³

Unknowns/Conflicts

The elderly population needs exercise in order to maintain a good quality of life and independence for as long as possible. There are many forms of exercise out there for the elderly that are beneficial to them, but which are the best? This question cannot be answered simply.

Various factors play a part in which form of exercise is best for each individual. For instance, a person that is in recovery from falling and breaking a hip may be looking for something that will give them a good workout, but will also have a low risk of injury associated with it. Additional factors could depend on which different types of injuries, diseases, or disabilities a person has. Each individual person would prefer or be recommended to pursue different physiological and psychological benefits from one another, depending on the severity and type of injury, disease, or disability. Each type of exercise offers its own set of physiological and psychological benefits due to differences in setting, intensity, and energy system utilized.

Thesis/Problem Statement

It is known that aquatic exercise can be beneficial to the elderly population. However, it is not known whether other forms of exercise would be safer and more beneficial. I will research each of these factors individually to determine which forms of exercise are best for the elderly population.

Research Questions

1. Which forms of exercise pose the lowest risk for injury?

I will compare and contrast on-land exercise risk of injury with risk of injury in and around different aquatic settings.

2. Which forms of exercise provide the best physiological benefits?

I will compare and contrast physiological benefits of aquatic exercise with physiological benefits of other forms of exercise.

3. Does aquatic exercise provide psychological benefits?

I will look into the benefits of aquatic exercise for the elderly with different psychological conditions or issues.

Other forms of exercise investigated will include walking and weight lifting.

Investigation Methods

To investigate the research questions listed, I will search through other researchers' findings in their personal research articles about aquatic exercise and other exercise for the elderly populations. This will allow me to compile already-known information into one

document. I will also look into case studies from recent years concerning different exercise prescriptions for elderly peoples with various health concerns, disabilities, or impairments. I will determine at least one form of exercise out of those listed directly below the research questions to compare to aquatic exercise within each research question.

Summary

Although much research has been done concerning benefits of exercise for the elderly population, I believe that each elderly individual has specific needs that require attention in different areas, such as the risk of injury and physiological and psychological benefits. These needs can be met by various types of exercise, but I believe that aquatic exercise is the best overall exercise for the general elderly population and that fitness professionals should educate themselves about aquatic exercise so they can make safe and informed recommendations for their elderly clients.

AQUATIC EXERCISE VERSUS OTHER EXERCISE

Introduction: Physical Properties of Water

Exercising in an aquatic setting is much different than exercising on land due to basic properties of physics. One of the most prominent differences between the two is that water has a buoyant property. According to Archimedes' Principle, "the loss of weight of a submerged body equals the weight of the fluid displaced by the body."^{4(p.108)} This means that a person will float if he or she weighs less than the water he or she has displaced. Most people can float, but it is dependent upon their body composition. The amount of buoyancy present is also dependent upon how much of a body is submerged. For someone that is standing in water up to his or her

waist, fifty percent of the body weight has to be supported. For someone that is standing in water up to his or her chest, twenty five to thirty five percent of the body weight must be supported. However, for someone that is standing in water up to his or her neck, only ten percent of the body weight must be supported. Because of buoyancy, people that are not able to exercise on land are usually able to exercise in the water. The effects of gravity are hindered by water and therefore a person is immediately lighter upon entering the water. This can have many physiological and psychological benefits that will be discussed later on.^{4(p.109)}

Another difference between exercising on land and exercising in water is that in water, there is a large amount of drag. Drag due to air resistance is present outside of water, but it does not provide nearly as much resistance as drag in the water. This is due to the higher viscosity of water compared to the viscosity of air. Viscosity is defined as “the friction between molecules of a liquid or gas, causing the molecules to tend to adhere to each other and, in water, to a submerged body.”^{4(p.101-102)} Because of the higher viscosity of water, exercising in an aquatic setting adds more resistance which makes normally low-intensity movements, such as walking, more difficult to perform.^{4(p.101-102)}

Hydrostatic pressure is another main difference between on-land and in-water exercising. It is the pressure that a person feels from the water pushing against his or her body. Out of water, there is pressure being exerted upon one’s body from the density of the air, but people are so used to feeling it that it is not noticeable. In the water, however, hydrostatic pressure can have an effect on the body both internally and externally. Due to gravity, it is easy for blood to settle in the lower extremities when a person is sitting or standing. When a person is standing in water, hydrostatic pressure on the lower extremities helps to bring that blood back up toward the heart, increasing the efficiency of circulation. If a person’s chest is immersed in water, hydrostatic

pressure makes the external intercostal muscles work harder every time the person inhales air. The water is exerting pressure on the chest that is not normally there when a person is out of the water, so those muscles can be conditioned in the water simply by being immersed.^{4(p.110)}

Because of these physical properties of water, aquatic exercise has different benefits than other forms of exercise that take place out of the water. Viscosity, drag, hydrostatic pressure, and buoyancy of water can all be used to the advantage of the elderly population. In this thesis, I will compare aquatic exercise with other forms of exercise in terms of risk of injury as well as physiological and psychological benefits.

Which forms of exercise pose the lowest risk for injury?

Because the elderly population is apt to have health problems due to complications from aging, the National Institute on Aging issued safe exercising tips. First, the elderly should take precautions to avoid injury. Some of these precautions include beginning with a low-intensity exercise, eating at least two hours before exercising, wearing good-quality athletic shoes and comfortable apparel, making sure to do a warm-up before exercising, drinking plenty of water throughout a workout as well as before and after, and being aware of the potential dangers of the workout setting. Secondly, the elderly should be sure to watch for any warning signs that their body is using to tell them to cease their workout. Some of these signs include any pain or pressure in the thoracic or brachial area, dizziness or nausea, cold sweats, cramping in the muscles, and intense pain in any joints or the lower body. If any of these symptoms occur, that individual should talk to his or her doctor about what steps he or she should be taking to monitor his or her health before exercising again.⁵

Aquatic Exercise Considerations and Risks

Because of the dangerous nature of water, there are many special considerations that must be made for older adults who wish to use a pool for exercise. Some of these include pool temperature due to the decrease in thermoregulation with age, ideal water depth depending on the abilities of the individual and appropriate footwear due to the decrease in friction in and around water. Other safety precautions include informing the patrons of where the lifeguards are located, procedures in case of an emergency, slippery areas around the pool, and accessibility of entrances and exits such as pool lifts, ramps, and ladders.^{4(p.206-207)}

According to the Aquatic Fitness Professionals Manual, for low-intensity exercise, a pool temperature of 86-88 degrees Fahrenheit is ideal; however, for moderate- to high-intensity exercise, the pool temperature should be 83-86 degrees Fahrenheit. In order for an older adult to have movement control, stability, and low-impact exercise, the pool water depth should be up to the chest or shoulders.^{4(p.206-207)} In the case that the individual has enough abdominal strength to maintain a vertical position in deep water, can enter and exit the pool without assistance, does not have any preexisting respiratory or heart conditions, is comfortable in deep water, and is in good physical condition, he or she may participate in deep-water exercise with supervision.^{4(p.182-183)} Aquatic footwear should be worn so that they can absorb shock, allow for use of orthotics while in the water, provide extra friction while moving or changing direction, and protect the bottom of participants' feet, especially those with diabetes or poor circulation. Taking all of these precautions can minimize the risk of injury or death while in the water, on the pool deck or in the locker room.^{4(p.88-89)}

In addition to taking all of these precautions, older adults need to be aware of the risk of falling. According to the CDC, one third of adults over sixty five years of age will fall every year. Falls are also the leading cause of injury among older adults. Ninety five percent of hip

fractures are the result of falls. Because of all of this, the elderly population must take extra precautions to avoid falling. Some of these precautions include making sure that vision is up to par, avoiding medicines that could cause dizziness, and exercising regularly to maintain good balance and strength.⁶ Due to the buoyancy and viscosity of water, older adults will not weigh as much in the water as they would on land and they will not be able to move as quickly.

Therefore, if they were to slip or fall while already immersed in water, they would have more time to react and they would also most likely float rather than sink to the bottom since only a very small population cannot float in water. On the other hand, when an older adult is walking along a slippery deck, it would be easy for him or her to slip and fall. This is why it is generally accepted that people should walk slowly and carefully on pool decks and that older individuals wear water shoes with traction on the bottom.^{4(p.88-89)}

Weight Lifting Considerations and Risks

Weight lifting, or resistance training, can be of great benefit to the elderly. However, there are also many risks associated with it, not just for the elderly but for all individuals that decide to train with resistance. Three of the main types of resistance training are isokinetic, isotonic, and isometric. Isokinetic is the least common method as it is used mostly in therapy. During isokinetic exercises, the muscle length and resistance are changing, however, the speed of the exercise remains steady. Isotonic is probably the most common type of resistance training referred to as it is any exercise in which the muscle length changes. This includes but is not limited to push ups, squatting, bicep curls, pull ups, etc. Isometric is also common but is not as referred to as frequently as isotonic exercises. An example of an isometric exercise is pushing up against a wall. The muscle length isn't changing since the wall doesn't move, but there is still resistance against the muscle.

No matter an individual's age or fitness level, there are always risks associated with resistance training. While using external force outside of body weight, there is always a risk of getting trapped under a weight or dropping it onto your foot, for instance. Therefore, a spotter should always be present so that someone is there to assist if an issue occurs. Some issues, however, tend to be more unique to the elderly population. One such risk has to do with the elderly performing isometric exercises. As an isometric exercise is performed, the muscles contract and therefore tend to constrict the blood vessels in the area. This is called vasoconstriction. In younger adults, this is okay because the blood vessels are fairly elastic and can easily dilate again to allow proper blood flow to and from the heart. In the older population, however, the blood vessels have slowly aged and are in turn not quite as elastic as they used to be. Therefore, the vessels have a hard time dilating again to allow that proper blood flow. If an isometric exercise is to be performed, it should be for a very short period of time so that the vessels are able to dilate once again without causing issues. Such issues include causing a large amount of stress on the heart due to increased systolic and diastolic pressures.⁸

Which forms of exercise provide the best physiological benefits?

As people age, certain physiological changes occur. Total fitness can decrease if a person does not stay physically active. The five components of physical fitness listed earlier can decrease sufficiently if a person does not continue to keep up on each of them over the years. Even if an older person has lost some of one component, it is possible to gain some of it back with training over time. Aerobic exercise requires at least twenty minutes of exercise that raises a person's heart rate to 65-85% of his or her maximum heart rate three times per week. Loss in this component usually comes from inactivity. Muscle strengthening requires lifting weight or using resistance. Muscle endurance requires doing resistance activities repeatedly until the

muscles start to tire or until fifteen to thirty repetitions have been completed. Flexibility is achieved with an optimal range of motion that can be gained by stretching for thirty to sixty seconds within a comfort zone. Body composition is the percent of fat mass in the body compared to the percent of non-fat mass. So many people focus on body weight but not on body composition when body composition is a much better measure of health.^{1(p.4-9)}

Aquatic Exercise Physiological Benefits

Each individual adult has different needs according to his or her physical condition. Therefore, each person can benefit differently from aquatic exercise because of their specific needs. A few benefits of aquatic exercise have already been discussed in previous sections, so this section will add to those. Some of the special populations that will be looked at will be people with arthritis, brittle bones, cardiac disease, diabetes, orthopedic impairments and disabilities, osteoporosis, Parkinson's disease, sensory impairments, and spinal and postural deviations.

Arthritis is an umbrella term for multiple disorders such as osteoarthritis and rheumatoid arthritis. Osteoarthritis is mainly seen in older adults since it is the result of using a joint so much that it eventually wears out. This can cause a weight imbalance on the joint's surfaces and can be very painful. For older adults with arthritis, the water must be kept warm and the participant should not exercise at a high intensity, but at a moderate intensity to avoid fatigue, discomfort, and soreness.⁷ Aquatic exercise is beneficial to these adults due to the buoyant property of the water. Even if a participant is only waist deep in the water, he or she only has to support about fifty percent of his or her total weight.^{4 (p.109)}

According to Ruth Sova, the author of *Water Fitness After 40*, aerobic fitness, muscle strength, muscle endurance, flexibility, and body composition can all be improved with aquatic exercise. First, aerobic fitness can be achieved by consistently doing twenty minutes of activity three times per week in which an individual's heart rate rises to sixty five to eighty five percent of his or her maximal heart rate. This will increase the fitness of the cardiovascular system which includes the heart, veins, arteries, capillaries, and lungs. Because doing aerobic activity expends more calories than being sedentary, it will assist an individual in either losing or maintaining body weight. It can also make respiration and blood circulation easier on the body as well as decrease the risks of coronary heart disease such as hypertension, obesity, and a sedentary lifestyle.^{1 (p.4-6)}

Secondly, muscular strength can be achieved by exerting muscular force. Although most individuals tend to lift weights to gain strength, water can act as the resistance needed for this gain especially when using equipment such as water weights made of foam so that they are difficult to push down into the water and also give minimal weight resistance above water.^{1 (p.7)}

Third, increasing muscular endurance can help an individual not to tire so quickly. Muscular endurance, or tone, is defined as "the ability to repeat resistance activities many times." Fifteen to thirty repetitions of any moderate intensity exercise will help to increase muscular tone. Water exercising can provide a moderate resistance in which an individual can walk in and increase his or her muscular endurance.^{1 (p.7).}

Fourth, flexibility is an overlooked component of fitness. Many individuals in their younger adult life will continue to stay fit in nearly every other category but will forget how important flexibility can be throughout the lifespan. Without this ability to move through an

adequate range of motion, some activities and even every day activities can become a hassle. Because gravity does not affect an individual as much in the water as it does outside of the water, he or she is able to move through a larger range of motion while submerged and feel more relaxed. Flexibility naturally decreases with age due to the joints becoming older, but that effect can be lessened with regular stretching and good mobility. Flexibility is extremely important to maintain throughout life so that activities of daily living such as putting on a seatbelt, getting dressed, and using the bathroom can be completed without much difficulty and without help.^{1 (p.8)}

Fifth, measuring health with body composition is much more important than measuring with weight. A body builder that is 6 feet tall and weighs 250 pounds is going to be much healthier than a sedentary person who is of the same height and weight. This is the difference between weight and body composition. Body composition takes into account the amount of fat mass and fat-free mass, or lean mass, that a person's body consists of. As the human body ages, it tends to lose some of its lean mass, which includes muscle, connective tissue, bone, etc. As an older adult loses weight, he or she does not just want to put on more weight by eating more since that will most likely cause an increase of fat mass. It would be beneficial for that adult to exercise and put that weight back on by increasing muscle or bone mass. Seventy seven percent of the calories expended during aquatic exercise is taken from fat mass, so it will maintain and even increase lean mass while decreasing fat mass.^{1 (p.9-10)}

Walking Physiological Benefits

While walking may seem like an everyday activity for some, it is an extremely vigorous chore for others. As a person ages, they develop posture patterns from various events in his or her life and it is reflected in the way they walk. Obesity can also cause joint issues that may

make it difficult to walk from point A to point B or even simply to stand up. About seventy percent of Americans over the age of fifty years old do not live active lives and therefore do not walk around much, so it is easy to get out of practice. According to Hippocrates, “walking is man’s best medicine.”⁹ (p.2-3)

Walking and aquatic exercise both allow for a person to become more fit, but since they are performed in different mediums with different effects of gravity, they are much different from one another. Some of the same problems associated with aging can be reduced or prevented through walking. Arthritis is one of these many issues. Walking can maintain calcium levels in bone from bone loading and it can also increase the strength of a person’s muscles and joints. Individuals that suffer from arthritis are cautioned from pushing too far too fast, though. They could be doing more damage than good for their joints if it hurts too much. It is all about body awareness. Recommendations from Dr. Kate Lorig include walking three or four times each week and keeping the distance within a ten percent increase every two weeks and nothing more. She also adds that if there is a period of time where the pain is coming back that the individual should take a step back until the pain subsides.¹⁰ (p.8-10).

Another issue includes back pain. This is not just a sign of aging. This can also be a problem for young adults if there is another problem causing the back pain. For older adults, back pain can come from muscle weakness or deteriorating vertebral discs. Walking can increase the strength of muscles in the pelvic and low back regions where much of the pain originates and it actually causes less pain than sitting without a backrest. Many adults don’t realize that walking is less stressful on their back than sitting can be. Posture is also extremely important while walking. If a person is not lined up correctly as they walk, they may be hurting their bodies instead of being helpful. Having straight posture means that while standing up

straight, one's ears should be directly over their shoulders, shoulders should be directly over hips, and hips should be directly over the ankles. While walking, the hips rotate and the ankles move forward and backward, so they won't maintain that perfect posture. However, the head should still be directly over the shoulders and the shoulders should be directly over where the hips were originally.^{10 (p.11-14)}

Diabetes is becoming more and more common among older adults. It is also becoming a factor for younger adults. Some children are born with the inability to produce insulin, which is called Diabetes Type I, but other individuals, regardless of their age, are losing the ability to use insulin properly due to a poor lifestyle, which is called Diabetes Type II or insulin resistance. A benefit to those with Type I that have tried a walking routine have found that they do not need to use as much insulin as they normally do because they have been taking part in the walking. It has been found that those with Type II can reverse the tendencies of the disease through eating better, exercising more, and losing weight. In the normal population without diabetes, it is recommended to walk three times per week. However, the diabetic population is encouraged to walk five to seven times per week. It is also encouraged for these individuals to take a snack of some sort with them in case they begin to feel hypoglycemic. Some other precautions for those with diabetes include taking care of their feet as blood flow can have low sensitivity to their feet and do not want to get blisters, staying cool without too much humidity, and keeping an ID with medical information present at all times.^{10 (38-41)}

Walking can also improve heart health, like many other forms of exercise. Walking is aerobic and this type of fitness has been proven to give an individual's heart a better chance when put under large amounts of stress. In a study that was conducted to view EKGs of the hearts electrical signals, a fit person had a more healthy response to adrenaline that is produced

during times of stress than an individual that is less fit. The T wave is a way to measure this response and it is recorded when the heart is taking in new blood. A walking program for a person with heart problems should always be approved by a physician first and foremost to prevent any unnecessary risk. It is recommended to walk about twenty minutes every day for three or more times each week and to try to keep your heart rate around a specific target heart rate determined by a physician.^{10 (p.78-82)}

Normal blood pressure for a healthy individual is 120/80, systolic over diastolic. Individuals with high blood pressure put a lot of unnecessary pressure on the heart. Walking regularly can decrease a person's blood pressure by five to ten mmHg. In a study where men were asked to exercise with a regular regimen for ten weeks while taking either a placebo pill or a high blood pressure pill, every subject's blood pressure dropped regardless of the medicine. Elderly adults take so much medicine already in the U.S. and this could mean that they would have one less pill to take every day if they were just walking instead.^{10 (p.82-85)}

Which forms of exercise provide the best psychological benefits?

As a person ages, it is natural to go through physical changes. But what others cannot see on the outside is that there are many internal emotional and psychological struggles that occur with aging. Some of these struggles include depression, learning to deal with the aging process and health issues, losing loved ones, and the possibility of declining cognitive function. These are issues that young adults begin to learn about and see from a distance, but when those young adults age enough to become considered a part of the elderly population, these issues become a reality.

A frequented study of aging includes the study of how exercise and physical activity can affect a person's psychological state. One such study investigated the effects of psychological stress and exercise on the likelihood of developing Alzheimer's disease. The researchers found that both stress and exercise can actually modify the pathophysiology of vascular disease in different ways. Stress actually increased the risk of developing Alzheimer's and exercise decreased the risk for developing Alzheimer's.¹¹ Findings like these have been progressing for decades. Back in 1984, the National Institute of Mental Health released a report claiming "that there were positive effects from acute and chronic exercise on anxiety and depression."^{12 (p.11)}

Stress of some sort is commonly felt by every person around the world. The elderly, although retired, may still face high levels of stress due to sources like medical bills or the well-being of their loved ones. Doing aerobic exercise, such as swimming, for bouts of about thirty minutes or more can have positive effects on the reducing the amount of stress the individual feels. If done for a few months, swimming could help to diminish chronic stress. Although it will not necessarily eradicate the source that the stress is coming from, it can be a distraction from the issue and allows the blood to flow efficiently through the body and mind, therefore giving off the feeling of clearing one's mind.^{12 (p.79)}

Depression is the most common reasons that adults seek therapy from a professional. About one third of the world is estimated to suffer from depression at some point in their lives.^{12 (p.131)} This is not an issue to take lightly. Many of the adults in the elderly population could easily suffer from depression due to loneliness because of the deaths of their loved ones or simply from coming to terms that they are approaching the end of their life. Although depression may seem inescapable, there are ways to deal with it once a person has come to acceptance.¹³

Studies have shown that even mentally healthy adults can benefit psychologically from exercising regularly. Even Hippocrates used exercise as a means to combat deep depression over 2500 years ago. In 1975, twice as many inactive female adults showed signs of depression than their fellow female adults that reported a moderate physical activity level. Nearly every study shows the same type of outcome.^{12 (p.133-136)} Indiana State University offers aquatic classes called Senior Splash that start with a warm up, then move into an aerobic workout, a cool down, and stretching to finish.¹⁴ As an employee at that pool for over four years now, I can personally attest to seeing adults begin and maintain relationships through that class that have helped them deal with certain events in their lives that could have been causing depression.

CONCLUSION

Exercise as a whole is largely beneficial to the elderly population. There are, of course, some risk factors associated with those exercises solely based on the nature of the exercise and the physiological stressors on the elderly. However, I truly believe that aquatic exercise withstands the test of time and will continue to grow in popularity over the next few decades due to extensive research and growing knowledge of healthcare and fitness professionals. Not only is it fairly safe for the elderly, but it can also render great benefits both physiologically and psychologically for participants of all ages and conditions. I am personally an avid swimmer, cyclist, and runner, and would never disregard any other exercises as beneficial to the elderly population. There are different types of benefits for walking, weight lifting, and aquatic exercise that can all complement one another. However, if an elderly adult had to choose one exercise above all others, I would highly recommend aquatic exercise as the most effective to live a long, happy life of the best physiological and psychological quality possible.

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