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One Degree

By Pamela G. Milling Aquatic Director/Water Fitness Instructor, Mississippi College Edited by Jessica Entrekin, B.S. Ed.

When the choice of exercise is "water fitness," the pool becomes an unavoidable liquid gym encircling most of the human body. Water has many properties and principles. It is capable of incomprehensible power. Water is an entirely different environment than land and can affect the human body both in favorable and unfavorable ways. In order for water to favorably affect water fitness exercisers, the water temperature is a key concern to water fitness professionals; it can hinder or assist the growth of any water fitness program. A one degree increase or decrease can make a noticeable difference. In this article, the term "water fitness exercise" indicates exercising in near-vertical alignment with the head above the water and the majority of the body submerged. The term "swimming" references exercising in near-horizontal alignment with the head partially in the water.

The temperature of water for different types of exercise provides an interesting study. To a seasoned water fitness exerciser, a one degree rise or drop in water temperature is quite noticeable. However, a one degree rise or drop for the land exerciser is usually not felt nor even noticed; it is certainly not felt as severely as it is in the water. At Mississippi College Alumni Pool, we have tried lowering the water temperature by "just" one degree, and the water fitness students have made accusations that ice cubes were placed in the pool overnight. The reason for this complaint is the chill factor. Just as meteorologists speak of a wind chill factor, water fitness educators speak of a water chill factor. The water chill factor is described as the apparent temperature felt on the exposed skin of a swimmer due to water temperature, air temperature, humidity, wind speed, amount of sunshine, cloud cover, level of exhaustion, and thickness of swimwear and head coverings. It incorporates heat transfer theory and heat loss from the body to its surroundings (OpenWaterPedia). This water chill factor also depends on body fat percentage, age, overall physical fitness, and the exercising pace.

When a person becomes chilled, it is assumedly because body heat is lost through the head. Popular myths lead one to believe up to 75% of body heat is lost through the head when on land. However, this has been reported as false (Ingebretsen). The real reason people lose heat through the head, according to Richard Ingebretsen, is because most of the time when they are outside in the cold, they are clothed. Speaking about land, Mr. Ingebretsen continued by saying that ordinarily only about 10% of body heat is lost through the head. The same amount would be lost through any uncovered section of the body. The net result of an uncovered head is a decrease of up to 10% in the total blood flow to the brain and a decrease in percentage of total body heat lost through the head (Ingebretsen).

Water, however, is a different environment than land, and water temperature is a major issue since it surrounds most of the body. Incorrect water temperature could result in hypothermia or hyperthermia. When the student exercises in water that is below or above their normal body temperature (the body has a very fragile range of temperature near 98 degrees), the body will react in different ways depending on a multitude of

factors. Two of those factors are listed below. However, few people understand the importance of the first factor:

- 1. Type of body alignment while exercising in various water temperatures.
- 2. Air temperature, direct sunlight, and percentage of humidity above the water while exercising.

Pools have tried to compromise water temperatures in the same pool in order to serve opposite populations that require different water temperatures. When PED water fitness students at Alumni Pool (an indoor pool) are not exercising very fast, in cycles of winded/recovery methods (interval training), they complain that they are chilly exercising at 85 degrees. However, these same students may place themselves in danger exercising when the water temperature increases by only a couple of degrees above 85. Whereas swimming students complain of overheating if the water is 83 degrees, unless they are swimming with their head completely out of the water (which could result in a back injury). From the mid-80's through most of the 90's, compromised water temperatures of 83-85 degrees at Alumni Pool produced the following complaints from both swimmers and PED water fitness students:

- When the water temperature was 83 degrees, the swimmers overheated while the majority of water fitness students complained that their teeth were chattering the entire time of exercise. Imagine how the water fitness students would have felt if the water temperature had been lowered to accommodate swimmers by even one degree.
- 2. Almost all water fitness students continued to complain when the water temperature was 84 degrees, and many dropped classes. Additionally, swimmers could not swim safely in 84 degrees.
- 3. At 85 degrees water temperature, swimming was hazardous; and the majority of water fitness exercisers still issued complaints.

An unknowing person might think that pools with such warm water must be therapy pools. However, this is not the case. Alumni pool is a workout pool. If a pool is used extensively as a therapy pool then it should have a minimum water temperature of 91 degrees up to a maximum of 95 degrees. But a few selected types of therapy can be held in a water temperature as low as 87 degrees (See). However, a therapy pool held at 87 degrees is too warm for the Alumni Pool water fitness workouts designed for Mississippi College's athletic teams.

Through the years, complaints about water temperature continued; neither the water fitness program nor the swimming program were excelling as expected. These continued complaints about water temperature eventually resulted in the necessary elimination of one of the existing programs. One of the programs had to be eradicated for the other one to grow. Which program would be discontinued; swimming or water fitness? This decision was a major burden since both programs were loved. Anytime there is a burden about a decision one knows that God is at work. Consideration of the facts and figures that an exclusive water fitness program would bring to Mississippi

College set the notion into action. Water fitness was the program that would bring about the best enrollment results from PED water classes, good attendance from athletic teams, and a great turnout from students/faculty/staff exercising for wellness or simply playing water fitness games for enjoyment. The perfect opportunity for this major change (resulting in neither program being left out) presented itself when the Baptist Health complex opened next door, in October, 1997. This is an excellent example of how God "opens windows of opportunity" when He needs His good purpose accomplished (Romans 8:28, Holy Bible, New International Version). The new complex next door had two pools; one was used for swimming and the other one was used in various ways. This meant Mississippi College students had the blessing of having 3 pools within walking distance of each other. Additionally, swimming opportunities would not be forfeited. The cutting-edge choice to make Alumni Pool a water fitness pool, even though it was originally looked upon by others as a radical choice, has proven itself over and over as an excellent decision.

The abovementioned windows of opportunity have revealed themselves in Christ-honoring ways for many years. One manifestation of this involves the true water fitness story that initiated the pool's motto, "When Water Moves Miracles Happen." This story, based on John 5:2-7, continues to be told every semester to the water fitness students (Holy Bible, New International Version). Another Christian aspect of the pool is brought forth by questioning the students about their reliance on water fitness exercises and relating this question to John 3:16 (Holy Bible, New International Version). These are only two of the many ways the water fitness program is serving God's good purposes. Today, the story and question have reached many more students than a swimming pool program could have ever reached by itself. Yet, in order for the water fitness program to continue growing, the perfect water fitness temperature still needed to be determined.

What are the factors involved in deciding upon a fixed water temperature?

In order to make good decisions about setting a water temperature, certain factors must be considered:

- 1. What is the size of the pool?
- 2. What is the cost of energy compared to the usage and income capability? In other words, what temperature will be cost effective? The efficiency of the pool is determined by the number of people that can exercise in the pool at the same time (this number is known as the hourly bather load total).
- 3. Which group of water exercisers will be the largest source of income, and how can the pool best serve the majority of students?
- 4. What other water programs will be compatible with the chosen water temperature?

Ultimate decisions for an established water fitness temperature at Alumni Pool were based upon the pool's maximum student potential along with the following information about swimming.

For safety, swim lanes are between 6 and 7 ½ feet in width. With 7 foot swim lanes, given that Alumni Pool measures 23' x 73', the pool could only have 3

lanes without collisions (U.S. Masters Swimming). However, Alumni Pool can hold 40 PED water fitness students at one time by having 20 in the deep end and 20 in the shallow end exercising with 2 coaches. Forty students per hour as a bather load total occur when Mississippi College's baseball team uses water fitness interval training to improve their field performance. Considering the ratio of 40:3 per hour, Alumni Pool's water temperature was set for water fitness (exercising with the head above the water) instead of swimming. This fixed water fitness temperature assists the pool in reaching its maximum PED enrollment potential. Once this potential has been reached the pool will establish an even more cost effective program than is presently in existence with the current 9 PED classes providing 196 registration spaces per semester. This future PED program is discussed in detail pages 7-10.

In choosing compatible water programs, many styles of classes were considered but only 6 were chosen since they were most compatible with the temperature needed for water fitness. The list below presently creates 196 PED registration spots each fall/spring semester with one full time instructor teaching 6 classes during the day and 2 adjuncts teaching evening classes (learn to swim and scuba):

- 1. Water fitness classes: PED 105A/B, 106A/B, 113, and 114 succeed well with the pool's environment in 85.5 degree water.
- 2. Cross-training or Volume-training: Students mix water fitness exercises: aqua power step, liquid abs, oodles of work, water baseball, deep water basketball, water volleyball, relay races, and other games such as tug-of-water. All of these work well in water temperature 85.5 degrees.
- 3. Interval training for athletes: With the existing air/humidity variables, plyometric splash, hydroriding (bicycles), and deep tethers can also be accomplished in 85.5 degree water.
- 4. Learning to Swim: The student learning the fundamentals of swimming in PED 107 is compatible with 85.5 degree water since these students vary from not knowing how to swim to being afraid of the water. This class does not swim laps.
- 5. Beginning and Advanced Scuba: PED 128A/B function well as they learn and practice the underwater techniques. The 85.5 degree water is beneficial to them; often they are barely moving underwater as they check instruments, practice breathing, and adjust masks.
- 6. Injured athletes: Mississippi College's athletic trainers determine the type of injury, if the injury can be rehabilitated in the 85.5 degree water, and what type of water fitness exercise is best for the injury. Most injured athletes use the hydroriders (bicycles) in the shallow end and also the deep water running to regain their physical fitness. While rehabilitating, they move at a slower pace than when cross training athletically in the water. Once healed, they return to the pool to train at a faster pace and incorporate all the water fitness cross training styles that will increase their performances on land. In doing so they gain an edge over their competition, which lacks the same type of water fitness training. An 85.5 degree temperature is perfect for these applications.

Why does a swimmer require a lower water temperature than a water fitness exerciser?

When swimming, metabolic heat is created by the body and carried to the skin by the blood. This blood is cooled by the air or water to manage the body temperature. The higher the water/air temperature, the less efficiently the blood is cooled. The problem with this from an exercise capacity standpoint is that when blood is shunted away from the core, it reduces the total blood volume available for transporting oxygen to the muscles (the cardiac output). This can have a significant effect on a person's swimming endurance during an exercise session (Washam, C. PhD., personal communication, August 23, 2012).

The swimmer exercises near the top of the water with their head partially in the water. Since the swimmer's head is partially in the water, the swimmer is increasing their core temperature as they travel in the water. Whether or not the swimmer is wearing a swim cap, their core temperature will increase. This increased body temperature is not released from the body. Under these circumstances, if the water temperature is not properly set for swimming then **it is like shoveling coal into an already hot furnace!** Their heated core temperature must have a cooler water temperature surrounding the body to protect the swimmer from overheating. Among the first signs a swimmer is overheating is the body beginning to itch. Many swimmers believe this itch is from the chemicals in the water (see chemical note below). However, if the water is balanced for exercising then the itch may be caused by the water temperature being higher than required for that particular swimmers pace. Itching can be a red flag that the swimmer may be in danger of hyperthermia.

Chemical Note: For years the sanitation system at Alumni Pool relied solely on chlorine (tablet and granular form) to kill pathogens. This grandfather system did not produce the ideal amount of chlorine needed throughout the day. Extensive renovation in 1997 produced many improvements in the pool structure, filtration system, and water treatment process. Subsequent research, consulting, and networking resulted in the installation of a noteworthy water treatment system. Chlorine is still utilized, being necessary and required by the local Health Department authorities. However, ozone now plays a leading role in the quest to create pathogen free water at Alumni Pool. Ozone is a gas comprised solely of oxygen, which is used to improve air quality, reduce allergens, etc. The ozonator of our choice is a product of Prozone International (based in Huntsville, AL). This specific unit is endowed with a patented feature referred to as a hybrid ozonator.

Aside from copious amounts of ozone, these hybrid units manufactured by Prozone simultaneously produce free radicals. To properly appreciate this exclusive and most important feature of the hybrid unit, one needs to understand the efficacy of ozone and free radicals. This is particularly evident when they are compared to chlorine. The use of chlorine as an effective water disinfectant is well documented and widely known. However, many people may be unaware that ozone kills pathogens thousands of times faster than chlorine (Barnes). Yet free radicals are even more powerful, faster-killing

agents than ozone! It should be noted that antioxidants are an essential component of our diets as they counteract and deactivate free radicals in our bodies. Conversely, these lethal free radicals are wanted and are paramount to the pathogen destruction in Alumni Pool.

The term "Advanced Oxidation Process" (A.O.P.) produces hydroxyl radicals (OH-) which constitute a highly potent oxidizer. Hydroxyl radicals are produced when ozone is used in conjunction with intense ultraviolet light and water. Ozone has a very short lifespan so a low level of chlorine is still required and maintained in the water (Barnes). A.O.P. more accurately defines Alumni Pool's water method of sanitation. The pool's ozonator, or advanced oxidation processor, has not only improved the disinfection aspect of the treatment process, but also the aesthetic quality. Alumni Pool's water can only be defined as stunningly clear (Reed, Roy, Memphis Pool Supply, Inc., personal communication, December 11, 2012). Because Alumni Pool is crystal clear and pathogen free using a small amount of chlorine, a salt water system has not been needed. Amazingly, many people misunderstand a salt water pool system and firmly believe salt water pools are chlorine free. In reality, salt water systems generate the exact same form of chlorine, HOCI, used to chlorinate pools.

Pay-back of the financial outlay proved to be quick as the Prozone unit, in itself, created a substantial reduction in chlorine usage. The addition of equipment for monitoring chemical control has resulted in automated, hands free operation (which is manually monitored for verification). These renovations and upgrades have given Alumni Pool a state of art status of which to be proud!

What temperatures are suitable for swimming?

Swimming, depending on the speed, requires a minimum of 77 degree water up to a maximum of 82 degree water temperature, per the FINA (Federation Internationale de Natation). However, in another reference, the beginning range for swimming changes by one degree (78 degrees) while the maximum temperature of 82 is held steady. (See). Some swimming programs even prefer one degree colder (76 degree water). These swimming ranges are for indoor pools, outdoor pools, and different swimming paces. The existing variables of the water chill factor (listed on page one, second paragraph) determine whether the water temperature needs to be 76, 77, 78, 79, 80, 81, or a maximum of 82 degrees.

What temperatures are suitable for water fitness?

Normally in an indoor pool (which lacks direct sunlight) the water temperature for water fitness exercises remains near 86 degrees. In contrast, an outdoor pool for the same type of exerciser is comfortable at the lower end of the water fitness requirement, or 83 degrees. An outdoor pool with warm sunshine should be much below 83 degrees for swimmers. Thus, in all variables, a single pool (whether indoor or outdoor) never satisfies both swimmers and water fitness exercisers. Both of these groups require different water temperatures for potential growth, and even one degree up or down will make a noticeable difference for either. The AEA recommends 83-86 degrees for water

fitness exercisers (See). This water fitness range is wide enough to accommodate indoor and outdoor pools with different variables for water fitness exercise.

Alumni Pool was renovated and re-opened on January 5, 1998. Over a period of years, different combinations of the variables were tried for the water fitness exerciser. Some combinations as listed below were planned while others were unplanned and occurred because equipment malfunctioned.

- 1. Water temperatures ranging from 76-88 degrees.
- 2. Humidity ranging from 54%-98%.
- 3. Air temperature above the water ranging from 75-90 degrees.

Combining water temperatures below 85.5 with the majority of the possible variables in #2 and #3, it was discovered that the chill effect of the water was too severe for the most water fitness exercisers. This held true even when caps were worn to help hold in body heat. However, caps are not recommended by the Aquatic Exercise Association (See). Additionally, anything over 86 degrees water temperature was too warm for the water fitness intervals used by the Mississippi College athletes. Through trial and error, it was determined which variables work best for PED classes, athletic team workouts, and students/faculty/staff exercising for wellness or playing water fitness games for enjoyment. These variables change little year round since they work so well:

- 1. 85.5 water temperature
- 2. 81 degree air temperature above the pool water
- 3. 54% humidity
- 4. Caps not used while exercising with head above water

Keep in mind, each pool is unique. An 85.5 degree water temperature for one indoor pool may not work as well in another indoor pool due to the different variables involved. It is important to note that in these trial and error determinations, the air temperature above the water actually had to be lowered below the water temperature, even though it is generally suggested air temperature should be set 2 degrees above the water temperature for the water fitness exerciser. The water fitness program has certainly benefited by the above list of temperatures with humidity control.

What is the goal for Alumni Pool's water fitness temperature of 85.5?

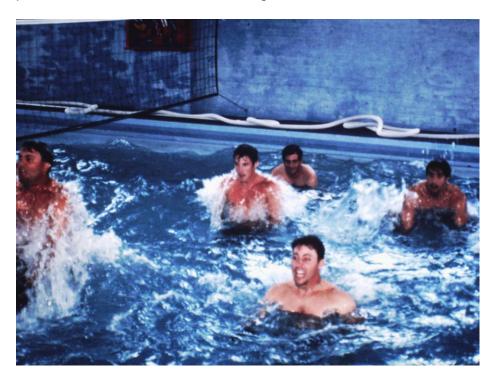
Several goals are achieved through a water fitness temperature of 85.5. These goals consist of financial, overall usage, and service potential. Alumni Pool achieves these goals through PED classes, athletic team workouts, students/faculty/ staff exercising for wellness, and playing water fitness games for enjoyment. A clear breakdown of these different goals is as follows:

- 1. PED classes satisfy the financial goal.
- 2. The maximum usage goal is accomplished by increasing the current hourly bather load total as students are exercising with water fitness.

3. Non-PED activities for students, including those for faculty/staff, satisfy the goal for fun, fellowship, and service as the picture below illustrates.



If Division 2 becomes a reality for the Athletic Department, Alumni Pool will be an exercise requirement for all athletes. This was the case in the 1990's as the following picture of Division 2 interval training illustrates.



However, at present, Alumni Pool is used as a Division 3 voluntary program. Division 2 will increase the number of athletes in water training, allowing them to perform at a higher level of physical fitness on land. Additionally, injuries on the track, court, and field will decrease compared to the current norms with Division 3. Programs for the

athletes are currently given as a free service to the Athletic Department (as are programs for non-PED students/faculty/staff).

At present the only way the financial goal can be reached is through PED classes. In addition, more registration spots are available if the PED classes are water fitness classes such as, Deep Water Running, Water Walking, or Water Aerobics; these have 25 registration spots each. At this time, there are only 9 PED classes per week, providing 196 registration spots. This supplies a good income for the pool each semester. These 9 PED classes employ one full time person along with two evening adjuncts. However, income for the pool could be increased further by teaching 22 PED classes per week. In doing so, this would produce a more cost effective program by creating over 400 registration spots. This could be accomplished with certain changes:

- 1. Employ 3 daytime water fitness professional instructors. Each of the water fitness instructors would teach at least 3 PED classes on Monday/Wednesday and also 3 PED classes on Tuesday/Thursday between 9:00AM-6:00PM.
- 2 Employ 2 nighttime adjuncts to teach 4 PED evening classes, Monday through Thursday, between 6:00-9:00PM, with 2 classes of Fundamentals of Swimming for the Non-Swimmer and 2 Scuba classes.
- 3 Have athletic coaches who are trained in water fitness interval training bring their Division 2 athletes for intense workouts between 6:00AM-9:00AM Monday through Friday. Consequently the Athletic Department could begin to support the pool budget if necessary.
- 4 From 9:00PM midnight, Monday through Thursday, hold student game events. Also, open the pool for students/faculty/staff to exercise for wellness on Fridays from 10:00 AM 8:00 PM, as well as on weekends. This would increase fun and fellowship time while opening more job positions for student lifeguards. These game events could include deep water basketball, shallow water volleyball, deep water polo, shallow water baseball, and relay races.

As stated, with the above instructors, Alumni pool could offer at least 22 PED classes for credit, enrolling over 400 PED students. But even with 22 PED classes, more PED classes can be added to help increase income and usage. This would be an ultimate goal and provide a superb income for the pool. Different PED classes could be held concurrently with one in the shallow end and the other one in the deep end. However, this would require additional instructors other than the 3 daytime water fitness instructors in the above scenario. By holding 2 daytime PED classes at the same time, these possible class combinations could develop:

- 1. Hydroriding & Water Walk (shallow); Liquid Abs (deep).
- 2. Water Aerobics (shallow); Deep Water Running (deep).
- 3. Plyometrics (shallow); Explosive Intervals (deep).
- 4. Beginner Water Volleyball (shallow); Oodles of work (deep).
- 5. Aqua Power Step (shallow); Athletic Races (deep).
- 6. Advanced Water Volleyball (shallow); Athletic Conditioning and Wall Work (deep).
- 7. Water Running (shallow); Tether Running (deep).
- 8. Four night classes 6-9PM: 2 Swim for Non-Swimmers and 2 Scuba.

One full time director/instructor would continue to handle office and equipment duties in between teaching PED classes, as is the case now. This high potential of water fitness usage at Alumni pool would be difficult to accomplish with any other variation of numbers and temperatures other than those previously stated. Reaching the pool's maximum student potential is not only a good business decision but is also a great service to Mississippi College. Currently, the Alumni pool water fitness program is working to maintain the 9 PED classes of 196 registration spots with one full time instructor/director, 2 adjuncts and an average of 10 student lifeguards per semester.

Does a heated indoor pool's water temperature change when electricity is lost or equipment is down?

Once electricity is out, depending how long it is out, various things begin to happen. For example:

- 1. The water temperature gradually drops as a result of air temperature, mass of concrete, etc.
- 2. Due to the evaporation of treated pool water and the rapid onset of the condensation condition, the windows/doors have to be speedily opened for venting. Some types of water fitness equipment must be covered for protection.
- 3. The water does not turn over the required amount of times during a 24 hour period necessary for health and wellness.
- 4. The chemical balance of the water changes.

In other words, a pool is almost immediately affected when electricity goes out and does not return to normal as soon as electricity is restored. It could be several days before it could safely re-open. This occurred during Hurricane Katrina in 2005. It also occurs each time the local Entergy sub-station serving the campus requires a necessary repair lasting overnight. Thus, it would be beneficial for the pool if it were connected to the large capacity generator sitting on the north side of Alumni Hall that runs the Campus Safety department when electricity is lost.

In addition, the pool de-humidifier system might stop due to reasons not addressed in this article. When electricity is on and this important unit ceases to run properly at Alumni pool, there is a second system, which is actually the primary system, but to not confuse the reader this back-up system will be called the secondary system. While it continues to control the water temperature, this back-up system does not control the air temperature or the percentage of humidity above the water. With the de-humidifier system not working properly, opened windows and doors help provide necessary fresh air not only for students and instructors but also for some important pieces of water fitness equipment as well. Without the de-humidifier working properly, the water temperature feels different to the skin despite remaining the same when heated from either system. If this happens during the summertime, the water temperature is perceived as an arctic blast to the skin, and the water fitness exerciser feels as if there are blocks of invisible ice floating near them upon entering the water. The water feels extremely cold even though it has not changed even by one degree. However, a swimmer would still overheat if they swam in this water, since the water temperature

would be higher than required for swimming even though it initially felt cold to the skin. This is because the air above the water is quite warm and the feel of the water next to the skin creates a false water chill. In the wintertime the exercisers perceive the reverse; the air is cooler above the water. The water temperature feels as though it has been radically heated even though it has not changed even by one degree. In an indoor pool, equipment and people are affected drastically and quickly when de-humidifier systems stop (see below pictures of before and after). Based on these situations it is clear that even without a degree change in water temperature, air temperature and humidity percentage above the water make an extreme difference.

BEFORE: DE-HUMIDIFIER SYSTEM WORKING PROPERLY AT ALUMNI POOL.



AFTER: DE-HUMIDIFIER SYSTEM NOT WORKING AT ALUMNI POOL.



Ambient temperatures will affect how indoor pool water (lacking a wind factor) feels to the skin.

This initial perception of how the water feels to the skin is noticeable even when equipment is working properly. This occurs when the outside daytime temperatures change within a 24 hour period of more than 19 degrees. For example, the average September in Mississippi has outside daytime temperatures of 86 degrees. In the midst of warm September, a slight cold front crosses the state during the night. The next day the outside daytime temperature has dropped swiftly to 66. The Mississippians then wear hats and jackets to come to the pool since the day is overcast and cooler. When they enter the water they announce with surprise that it feels warm. In cooler weather, the skin exposed to the outside elements is cool, and the water feels warm in contrast. In warmer weather, the skin exposed to the outside elements is warm. The water then feels cold to the warm skin. These conditions will affect the initial perception of how the water feels against the skin even when equipment is working perfectly. When this occurs, students must be reminded the water temperature is 85.5 constantly, and has not changed, even by one degree.

Can a pool's water temperature be changed as quickly as indoor air temperatures can be changed?

Usually pool water temperatures are not quickly changed; this depends on the size of the pool. Even a small pool with 25,000 gallons cannot suddenly change up or down one degree as needed on an hourly basis for different styles of exercise. Thus, the water temperature of a pool is set to hold the same temperature on a steady basis unless there is a problem with the equipment or electricity is lost.

Conclusion:

Professionals can watch enrollment grow by choosing temperatures suitable for water fitness. The snowball effect of water fitness programs developing across the nation could boost the economy in various ways. For example, it will certainly help with healthcare costs by offering immense physical benefits to water fitness users. It would be a win/win situation.

Note from Jessica Entrekin: For examples of the amazing physical benefits of water fitness exercise, look at the pool director's previous articles at www.mc.edu/water-fitness.

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