THE EFFECTS OF A SUPPLEMENTAL THERAPEUTIC AQUATIC EXERCISE PROGRAM ON THE PHYSICAL FITNESS LEVELS OF SPECIAL OLYMPIC ATHLETES

by

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The purpose of this study was to examine the effects of participation in a supplemental aquatic fitness program on the physical fitness (muscular strength, cardiovascular endurance, and flexibility) of children with developmental disabilities who also participate in Special Olympics programming, as compared to children who participate in Special Olympics programming alone. Fourteen children with developmental disabilities who were active participants in Special Olympics programming participated in the study. Of the 14 children, six participated in a supplemental therapeutic aquatic exercise program in order to see if participation would increase physical fitness levels. Participant physical fitness levels were assessed using the Brockport Physical Fitness Test. No significant gains in physical fitness levels were observed in the children who participated in Special Olympics programming alone. In addition, no significant gains were found in the children who participated in both Special Olympics programming and the aquatic program. This study suggests that physical fitness levels are not increased by regular Special Olympics programming. Consequently, a supplemental program to provide more physical activity and, therefore, increase physical fitness levels in children with developmental disabilities is still needed. However, the aquatics program used in this study in conjunction with Special Olympics programming also found no significant gains in physical fitness. A

supplemental aquatic exercise program with increased frequency, duration, and intensity may still be effective although further research is needed to test this claim.

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by

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Introduction

People with developmental disabilities are one of the largest sub-populations in the United States. In a longitudinal study (1997-2008) on the prevalence of developmental disabilities in children ages three to 17, Boyle et al. (2011) indicated that 13.87% of US children were diagnosed with a developmental disability. In addition, approximately one in six children reported having a developmental disability in the United States between 2006-2008.

A developmental disability as defined by the Developmental Disabilities Assistance and Bill of Rights Act of 2000 (Public Law 106-402) is “a severe, chronic disability that is attributable to a physical or mental impairment that is likely to continue throughout the person’s life and results in functional limitation in three of more areas of life activities” (2000).

Role of Physical Activity for Persons with Developmental Disabilities

The role and importance of physical activity for children with developmental disabilities is well documented in the literature (Finch, Owen, & Price, 2001; Frey & Chow, 2006; Longmuir & Bar-Or, 2000; Temple, Frey, & Stanish, 2006). Regular physical activity can help prevent many secondary conditions that children with developmental disabilities are at risk of developing including cardiovascular disease, type II diabetes, high blood pressure, obesity, and osteoporosis. Other secondary impairments may include osteoarthritis, decreased balance, reduced strength, poor fitness, weak endurance, poor flexibility, and depression (Johnson, 2009). In addition to preventing secondary conditions and impairments, regular physical activity and exercise can also improve physical fitness levels.

There are three primary components of physical fitness: (1) cardiovascular endurance, (2) muscular strength and endurance, and (3) flexibility (Rimmer, 2009). Children with developmental disabilities can increase their physical fitness levels by participating in physical activity programming that addresses their specific needs (Rimmer, 2009).

Special Olympics

Special Olympics is a program for individuals with developmental disabilities designed to help them "develop physical fitness, demonstrate courage, experience joy and participate in a sharing of gifts, skills and friendship with their families, other Special Olympics athletes and the community" (Special Olympics, 2010, para. 1). However, the frequency, duration, and intensity of Special Olympics programming does not provide enough physical activity to effect physical fitness levels (Special Olympics, 2005). In order to address the increasing problem of decreased physical fitness in these athletes, other programs need to be developed that involve exercise and physical activity.

Land Based Physical Activity and Developmental Disabilities

For children with developmental disabilities, regular fitness is encouraged in order to prevent diseases and promote physical well-being (Blundell, Shepard, Dean, & Adams, 2003; Darrah, Wessel, Nearingburg, & O'Connor, 1999; Dyer, 1994; Fragala-Pinkham, Haley, & Goodgold, 2006). In a study by Fragala-Pinkham, Haley, Rabin, and Kharasch (2005), it was demonstrated that, as compared to a home based fitness intervention, group fitness classes designed to meet the needs of children with developmental disabilities may produce significant changes in strength, endurance, self-perception, and functional and gross motor abilities.

Fitness programs for children with disabilities can sometimes be difficult to create. "Adaptive exercise equipment, fitness assessments specifically designed for children with disabilities, behavioral management interventions, and medical precautions may be required for safe and effective participation" (Fragala-Pinkham et al., 2006, p. 159). However, with the right mix of instructors, facilities, and equipment, significant improvements may be observed.

Many researchers choose to study the effects of physical activity on specific sub-populations of developmental disabilities including people with Down syndrome (Dyer, 1994; Lewis & Fragala-Pinkham, 2005; Millar, Fernhall, & Burkett, 1993) and cerebral palsy (Blundell, Shepard, Dean, & Adams, 2003; Darrah, Wessel, Nearingburg, & O'Connor, 1999).

Because of the risk of chronic diseases can be heightened by obesity and a sedentary lifestyle, physical activity must become part of a child with Down syndrome's daily life. To achieve cardiovascular benefits for children with Down syndrome, a combination program of aerobic conditioning and strength training is more effective than aerobic conditioning alone. In order for the programs to be effective for individuals with Down syndrome, the participant must exercise at a moderate to high intensity for a minimum of 30 minutes, five to six days per week (Lewis & Fragala-Pinkham, 2005).

Cerebral Palsy (CP) is another developmental disability, where the individual can experience decreased range of motion, muscle strength, and cardiovascular endurance (Darrah et al., 1999). It has been found that muscle strength can be improved in adolescents with CP who participate in a regular community-based exercise program that includes aerobics, weight training, and flexibility exercises (Darrah et al., 1999).

Although land-based programs may sometimes be effective, the use of land-based exercise programs can sometimes pose a safety risk to children with developmental disabilities. Therefore, alternative low-impact exercise programs are recommended (Lewis & Fragala-Pinkham, 2005).

Aquatic Exercise and Developmental Disabilities

Research suggests that exercise programs like those outlined above can improve the fitness levels of children with developmental disabilities. However, without proper guidance, children with disabilities may be at risk for injuries from land based strength training and aerobic exercise programs (Fragala-Pinkham et al., 2008). In addition, children who have difficulty with motor skills may be more successful in alternative low impact activities, as compared to land. Due to the combination of weightlessness and the opportunity to practice different movement patterns without the fear of injury, aquatic based programs are an appropriate alternative (Prupas, Harvey, & Benjamin, 2006).

Low impact exercise is widely recommended for children with developmental disabilities (Fragala-Pinkham et al., 2008). Therapeutic aquatic exercise is one example of low-impact exercise, because joint loading forces are greatly reduced while, at the same time, the water provides resistance that may be used to increase muscle strength and aerobic capacity. Some research has provided support of the therapeutic benefits of aquatic exercise for children with developmental disabilities.

In the study by Fragala-Pinkham et al. (2008) with a group aquatic aerobic exercise for children with disabilities, the results provided support that cardiorespiratory endurance increased as indicated by an increased time on the half-mile walk/run. Improvement in exercise capacity was also noted by an increased ability to exercise for longer periods of time in their target heart rate (HR) zone. The authors' conclusion was that group aquatic exercise was a fun alternative to land based activity for improving cardiorespiratory endurance in children with disabilities.

Yilmaz et al. (2009) completed a study on the effects of water exercises and swimming on physical fitness of children with intellectual disabilities. The results of this study indicated that the children improved significantly in all six dependent variables of physical fitness, including the 25-yard dash, upper extremity strength and endurance, lower extremity strength and endurance, agility, balance, and cardiovascular endurance. Considering the limitations and sedentary lifestyles of many children with intellectual disabilities, aquatic exercises can be an effective approach to developing physical fitness and motor skill development skills.

Rationale for the Use of Therapeutic Aquatic Exercise

Therapeutic aquatic exercise is simply defined as the use of aquatic exercises designed to aid in the rehabilitation of various disabilities and conditions (Bates & Hanson, 1996). The use of swimming and exercise activities in the water have benefits that are well documented in the literature (Broach & Datillo, 1996; Campion, 1985; Davis & Harrison, 1988). The ultimate goal of therapeutic aquatic exercise is to "prevent dysfunction and aid in the development, improvement, restoration, or maintenance of normal function including muscular strength and endurance, flexibility and mobility, relaxation, coordination, and at the appropriate time, cardiovascular endurance" (Bates & Hanson, 1996, p. 40).

The principles and properties of water. For individuals with disabilities, the therapeutic properties of water create "an environment for exercise which is more conducive to achieving treatment goals than exercise conducted on land" (Broach & Datillo, 1996, p. 213). Additionally, the functioning of all major muscle groups can be improved through the use of therapeutic aquatic exercise without the impacts of land based physical exercise. Therapeutic aquatic exercise programs are successful sessions when the therapist addresses the body's physiologic response to water immersion and the general physical properties of the aquatic environment (Bates & Hanson, 1996). Defining properties of water that facilitate effective outcomes through therapeutic aquatic exercise include relative density, buoyancy, hydrostatic pressure, temperature, and turbulence.

The physiologic benefits of exercising in water. The literature supports the use of exercising in water to produce benefits that may have the potential to enhance the quality of life for people with disabilities. Physiologic benefits of immersion and movement in the water have been well documented in the literature (Broach & Datillo, 1996; Campion, 1985; Davis & Harrison, 1988).

Exercise in an aquatic environment can produce strength and endurance gains that may not be possible during land based exercise. The properties of water provide for an increase in resistance to movement and allow the joints to move with greater ease (Bates & Hanson, 1996). When body parts are submerged in water they encounter resistance in all directions of movement. Therefore, movement in water requires greater energy expenditure than movement on land.

Water exercise can also improve respiratory muscles and vital capacity. In chest deep water the increase of the hydrostatic pressure on the chest walls makes breathing more difficult. By utilizing aerobic oriented aquatic activities, an increase in respiration is possible. In addition, techniques such as blowing bubbles can be used to train the breathing aspect of respiration for patients who have respiratory problems (Bates & Hanson, 1996).

Skinner and Thompson (1989) documented several additional physical benefits of movement through water including relaxation, relief of pain and muscle spasms, maintained or increased range of motion in joints, and reeducation of paralyzed muscles. In addition, the water stimulates sites where the body takes in information. For individuals with disabilities who require sensory stimulation, aquatics can serve as an important adjunct to other therapy (Lepore, Gayle, & Stevens, 2007).

Finally, a major advantage of therapeutic aquatic exercise is that "it may enhance functional ability that encompasses all areas of life and helps to develop a life-long leisure activity that can be enjoyed with other people" (Broach and Datillo, 1996, p. 224). Keeping in mind the individuals' condition, strengths, and weaknesses, the use of an aquatic environment, as opposed to a land based environment, while exercising can substantially improve the participant's quality of life.

Statement of the Problem

There is strong evidence provided in the literature to support the claim that children with developmental disabilities are among the least physically fit populations in the world (Healthy People 2010, 2001). Programs like Special Olympics have provided opportunities for physical activity. However, it is evident that participation in practices and competition is not typically enough to maintain healthy fitness levels. It is, therefore, essential that practitioners develop more programs focused on improving the physical fitness of children with developmental disabilities. While land-based programs offer a range of benefits, they may not always be the best choice for children with developmental disabilities due to the increased risk of injury. It follows that an aquatic fitness program aimed at improving strength, flexibility, and endurance may be a viable option.

The purpose of this study was to examine the effects of participation in a supplemental aquatic fitness program on the physical fitness levels (muscular strength, cardiovascular endurance, and flexibility) of children with developmental disabilities who also participate in Special Olympics programming, as compared to children who participate in Special Olympics alone.

Methodology

The research design for this study is a pre-test - posttest quasi-experimental design. Athletes, between the ages of 8 and 18 years, enrolled in the Pitt County and Wake County, North Carolina Special Olympics programs were engaged in either the Special Olympics training program and aquatics exercise or Special Olympics training alone.

Participation was voluntary; therefore the sample could not be randomized. A sample of 14 children ages 9-15 self-selected to participate in this 10-week, quasi experimental study. Six children were placed into the aquatic exercise and Special Olympics (SO) group and eight participants were enrolled in the Special Olympics Only group. The ability to understand directions and participate safely in an aquatic exercise program was a prerequisite to participation in the aquatic intervention group.

Measurement

The primary variable tested was the physical fitness levels of the Special Olympic athletes. Physical fitness was assessed pre-treatment and post-treatment using the Brockport Physical Fitness Test (BPFT).

The three primary components of physical fitness were: (1) cardiovascular endurance, (2) muscle strength and endurance, and (3) flexibility. Each of these variables was measured using four of the twenty-seven tests in the BPFT. The BPFT claims three different types of validity: concurrent, construct, and logical (or content). Each of the 27 individual tests within the BPFT has been assessed for one or more types of validity (Winnick & Short, 1999). In addition, at least minimal levels of acceptable reliability have been established for all tests in the BFPT. Reliability coefficients greater than .70 are considered minimally acceptable estimates of score consistency, while values in the .90 range indicate a high degree of reliability (Winnick & Short, 1999).

Cardiovascular endurance (16-Meter PACER). Cardiovascular endurance was measured using the 16-M PACER test. The 16-M PACER suggests evidence of concurrent validity with peak VO_2 (r = .77). This relationship with VO_2 max (maximal oxygen consumption) indicated a criterion measure of cardiovascular endurance. The correlations can be considered at least moderate when r=.70-.89. The 16-M PACER provides evidence of reliability (α = .96-.98) (Winnick & Short, 1999). The 16-M PACER test requires the participant to run as long as possible back and forth across a 16-M distance at a specified pace, which gets faster each minute.

Muscular strength and endurance (modified curl-up). Abdominal strength and endurance was measured using a modified curl-up. Validity for the modified curl-up is considered logical validity. Logic given for the inclusion of the modified curl-up is that the element includes the use of fatigue resistant trunk muscles that "maintain spinal and pelvic alignment, provide stability, and allow for controlled movement" (Plowman & Corbin, 1994, p. 92). Winnick and Short (1997) found a one week test-retest *a* (alpha coefficient) of *a* = 0.82 for the modified curl-up test. The Modified Curl-Up requires the participant to perform as many curl-ups as possible, up to a maximum of 75, at a cadence of one curl every three seconds.

Muscular strength and endurance (extended arm hang). The extended arm hang was used to evaluate upper body strength and endurance. Logical validity can also be claimed for the extended arm hang. Evidence of the extended arm hang's reliability is α = .85 (Winnick & Short, 1999). The extended arm hang element requires the participant to hang from a bar for as long as possible, up to 40 seconds.

Muscular strength and endurance (flexed arm hang). The flexed arm hang was used to evaluate upper body strength and endurance. Evidence of construct validity is provided for the flexed arm hang in that the item "loads" with related items in a factor analysis (i.e., strength). The reliability of the flexed arm hang is $\alpha = .93$ (Winnick & Short, 1999). The flexed arm hang requires the participant to hang from a bar and maintain a flexed arm position (chin above the bar) while hanging for as long as possible.

Flexibility (back-saver sit and reach). Lower body flexibility (hamstrings) was measured using the Back-Saver Sit and Reach test. Evidence of logical validity can also be claimed for the back-saver sit and reach test as it assesses the flexibility of the hamstrings. The back-saver sit and reach reports a reliability of $\alpha = .95$-.96 (Winnick & Short, 1999). This test asks the participant to reach across a sit-and-reach box while keeping one leg straight.

Protocol

The researcher recruited participants, ages 8-18 for this study. Eight is the minimum age for participation in a Special Olympic sport. Recruitment resulted in participants who were Special Olympic athletes with a developmental disability between the ages of 9 and 15 years.

Volunteer athletes were enrolled to either the TAESO group or the SOO group who were engaged in standard Special Olympic training. Participants with a fear or reluctance for engagement in the therapeutic aquatic exercise program were not included. Expected benefits from participation in the aquatic program were explained to all participants and their parents/guardians. Consent for participation was secured from all parents/guardians of participants. Assent was secured from the participants. The researcher obtained written permission forms from all parents in person prior to or at the start of the program. The researcher was also available on-site to answer questions from parents/guardians and participants.

For the therapeutic aquatic exercise and Special Olympics group, pre-testing was completed on all athletes prior to the first therapeutic aquatic exercise session and following the last session. For the Special Olympics only group, testing took place at separate meetings with a ten-week span between pre and post-test measures.

Participants were engaged in a therapeutic aquatic exercise program compatible with the structure of the program proposed by Yilmaz et al. (2009). Each therapeutic aquatic exercise session lasted 45-60 minutes, two times a week for 10 weeks. Exercises focusing on the three components of physical fitness were included in each session. [Insert Table 1: Therapeutic Aquatic Exercise Protocol]

Results

Results of the data analysis include demographic information and fitness measures. Descriptive statistics reflect the composition of each group. Paired t-tests were employed to determine change among groups [Special Olympics Only (SOO) vs. Therapeutic Aquatic Exercise & Special Olympics (TAESO)]

Demographics

A total of 16 participants (Therapeutic Aquatic Exercise and Special Olympics Group n = 8; Special Olympics Only Group n = 8) volunteered to take part in the study. Due to low attendance rates at therapeutic aquatic exercise sessions, two children did not complete the post-test. Therefore, 14 participants' data were analyzed in this study. Of the 14 participants in the study, the mean age was 12.14 years, with a range from nine years to 15 years. There were a total of five females and nine males.

The SOO group ranged in age from 12-15 years, with a mean age of 13.75 and was comprised of six males and two females (See Table 2). The TAESO group ranged in age from 9-

12 years, with a mean age of 10.00 and consisted of three males and three females. Each participant in both groups was classified as having a developmental disability. All participants except one were classified as having an autism spectrum disorder. [Insert Table 2: Descriptive Statistics]

Brockport Physical Fitness Test

The results of paired samples t-Test on the TAESO group mean change can be found in Table 3 and the SOO group mean change can be found in Table 4. Differences between pre and post-tests on all five physical fitness items were analyzed.

On the PACER test, there were no significant gains for either the TAESO group or the SOO group at the $p < .05$ level of significance. While the pre-test post-test gain of the SOO group approached significance at .061, the bulk of the gain was realized by two members in the SOO group. Their significant gain was inconsistent with the other athletes and cannot be explained from the data generated.

The lack of significant gain held true for other measures of the Brockport Physical Fitness Test. The Modified Curl Up Test gain from pre to post test of the TAESO group and the SOO group recording significance at the .397 and .428 respectively. On the Extended Arm Hang Test, no significant change was realized for either group. The mean change of the Flexed Arm Hang was also not significant in mean change from pre to post test. On the Back Saver Sit and Reach Test, there were no significant gains for either group. Overall, pre to post gains by either group demonstrated no significant gains ($p < .05$) for either group in any of the five items on the Brockport Physical Fitness Test.

[Insert Table 3: Paired Samples t-Test Pre vs. Post - Therapeutic aquatic exercise and Special Olympics group (Mean, SD, and sig.)] and [Insert Table 4: Paired Samples t-Test Pre vs. Post – Special Olympics Only Group (Mean, SD, and sig.)]

A comparison of the TAESO and SOO group performance on the five items of the Brockport Physical Fitness Test to the specific standards outlines in the Brockport Physical Fitness Test manual reflect varying performance on each of the measures for individuals in each group. For instance, the TAESO group, with the exception of one subject, and the Special Olympics Only group performed below the standard on the PACER test (See Table 5).

On the Modified Curl-Up Test, all but two of the participants in the TAESO group met the standard. This same result also holds true for the SOO group where all but one individual performed to the standard set by the BPFT (See Table 6).

When comparing the performance of the two groups on the Extended Arm Hang to BPFT standards, it should be noted that standards were only established for the 10 – 12 age ranges. None of the participants met the standard set for the Extended Arm Hang Test (See Table 7).

The Flexed Arm Hang Test has established performance standards for ages 13-15 with no standards set for the 9-12 age group. Therefore, only participants in the SOO group could be compared. Of the eight participants, only three met the standard (See Table 8).

On the Back Saver Sit and Reach Test standards are set for 10-15 years of age. However, on the measure, all of the TAESO and SOO members met or exceeded the published standards for the measure (using the 10 year old measure for the 9 year old participants) with the exception of one individual in the TAESO group (See Table 9). [Insert Tables 5, 6, 7, 8, and 9]

Discussion

While no significant gains in physical fitness were found for either group, several observations can be made of the current study. In addition, there are recommendations for future research efforts.

Implications for Therapeutic Aquatic Exercise Protocol. The outcomes of this study did not demonstrate significant changes in physical fitness for participants in the TAESO group. It would be important, therefore, to examine facets of the program and suggested modifications. With regard to frequency, intensity, and duration of the intervention, the choice was made to create a 10-week program, two times a week, for 45-60 minutes per session. This protocol was based on the work of Yilmaz et al. (2009) study on the effects of water exercise on children with intellectual disabilities. The Yilmaz et al. study observed significant positive results in all six of the dependent variables (25 yard dash, upper extremity strength and endurance, lower extremity strength and endurance, agility, balance, and cardiovascular endurance). In contrast, the current study observed no significant results on any of the five variables tested for either group. It should be noted, however, that the participants in that study were all selected because they had no prior physical activity experience. Therefore, the potential for performance gains for participants in the Yilmaz et al. study may or may not have been greater than that of the participants in the current study. The physical activity literature indicates that the greatest room for improvement in fitness is witnessed as non-participants first begin to exercise (Pangrazi, 2000). This may account for the significant findings in the Yilmaz study that were not observed in the current study.

While the participants in this study were actively enrolled in Special Olympic sports, their fitness measure, with the exception of the Back Saver Sit and Reach Test, were below published standards. Despite being active participants in Special Olympic sports, the TAESO group required a modification of the protocol in order to produce significant gains.

A modification of the Yilmaz et al. protocol regarding frequency of training, intensity of training and duration of training may be needed to generate positive outcomes. For instance, the group may need to engage in the therapeutic aquatic intervention more than twice per week. Given that the most sessions any one individual missed was two therapeutic aquatic exercise sessions, the frequency of sessions may be worth examining. Current U.S. physical activity standards for children recommend that children and adolescents accumulate a minimum of 60 minutes of physical activity daily (Centers for Disease Control and Prevention, 2011). Engagement in only one hour of planned exercise was likely insufficient to make fitness gains. With more frequent involvement, more significant gains may be realized.

The therapeutic aquatic exercise protocol may also require an increase in intensity. The protocol called for approximately 30 second bouts of exercise for several activities, these bouts could have been extended to up to 60 second intervals to increase the intensity of the therapeutic exercise program. In addition, an increase in both repetitions and sets for the water dumbbell activity may produce greater results in muscular strength. The Centers for Disease Control and Prevention (CDC) recommends that children receive at least 60 minutes of physical activity per day. While the CDC recommendations do not specify how much of the daily activity should be devoted to individual areas of fitness, it does offer general guidelines. The 60 minutes of activity should include daily aerobic activity, muscle strengthening activity at least three days per week, and bone strengthening activity at least 3 days per week as part of the 60 minute requirement (Centers for Disease Control and Prevention, 2011). While the protocol used with the TAESO group included strengthening activities, the weak post-test gains reflected the need to increase muscle strengthening components as suggested by the CDC.

The therapeutic aquatic exercise protocol lasted 10 weeks in duration. An extension of the program by four additional weeks may produce greater results. This recommendation is based on Fragala-Pinkham, Haley, and O'Neil's (2008) protocol that found significant improvements in physical fitness levels after 14 weeks. The extended duration in combination with an increase in frequency and intensity should produce more positive increases in physical fitness levels.

Finally, interspersing fitness retesting to familiarize the participants with the demands of items on the Brockport Physical Fitness Test may produce greater gains for the participants. The integration of one additional testing on the items of the Brockport Fitness Test at the mid-point of the protocol may offer participants reinforcements for better performance. There is a risk that an additional testing may result in test familiarity. However, as identified by Deci and Ryan (2000), positive feedback increases feelings of competence. In turn, additional testing may be warranted in order to secure more accurate performance data for comparison.

Implications for Practice

While results of this study did not provide statistical evidence of differences between an aquatic group and a general Special Olympics group, there are numerous implications for practitioners working with individuals with disabilities. Given the results of this study, supplemental programs aimed at promoting fitness for children and youth with developmental disabilities is still a worthy endeavor. It seems essential that programs be designed to provide more physical activity geared toward increasing physical fitness levels in children with developmental disabilities. While the aquatics program used in this study, in conjunction with Special Olympics programming, did not produce significant gains in physical fitness, modification in the therapeutic aquatic protocol may generate better results.

Perhaps the key to addressing this issue is to identify those activities that the child with a disabling condition are receptive to participating and integrating that activity into a fitness strategy as a means to improve fitness measures of children with developmental disabilities. Practitioners working with individuals with disabilities need to provide adequate assessment of individual fitness levels and incorporate structured fitness programs from these identified recreation interests to promote long term participation.

This study does demonstrate the need for additional research on alternative strategies for improving the fitness level of children with developmental disabilities as a supplement to Special Olympics participation. While the aquatic intervention did not produce significant changes, the results may reflect the need to modify the aquatic intervention protocol in the frequency of sessions, the intensity of the aquatic sessions, and in the duration of the sessions offered in order to produce greater gains. Practitioners may want to consider developing aquatic exercise interventions that provide longer frequencies of involvement to promote improved chances of changing fitness levels of participants.

Practitioners may also want to consider other alternative, low impact strategies, to respond to the need for improved fitness among persons with developmental disabilities. For instance, Tai Chi (Channer, Barrow, Barrow, Osborne, & Ives, 1996; Schaller, 1996) and Yoga (Berger & Owen, 1992) are both low impact strategies that have proven effective in improving physical fitness, flexibility, balance, and general core strength. It may be that the introduction of such low impact activities may also prove beneficial as an adjunct to Special Olympics participation.

Limitations of the Study. As presented by Johnson (2009), "stringent studies of physical activity in youth are difficult to conduct because of confounding factors and the diversity of disability and impairment (p. 163). This study addressed the effects of a therapeutic aquatic exercise protocol as an adjunct to Special Olympic sports participation. While the participants were almost all classified as having autism, the diversity of age, individual capability, and prior sports participation are limitations and make comparisons between the TAESO and SOO groups impossible. While accessing comparison groups or even matching subjects for this study would have been beneficial, the number of potential participants made these techniques impractical. The application of a single subject design research similar to Yilmaz, Yanardag, Birkan, and Bumin (2004) may have been a more productive approach to testing outcomes related to testing the impacts of a therapeutic aquatic exercise program on fitness measures of children with developmental disability.

The Special Olympics Only group was originally intended to be a comparison group to the Therapeutic Aquatic Exercise and Special Olympics group. However, when comparing the two groups, it was noted that the mean age of the Aquatics and Special Olympics group was 10.00 years. The mean age of the Special Olympics Only group was 13.75 years. A difference of nearly four years between the two groups reflected different developmental stages and, therefore, made comparisons between the two groups problematic. A more effective sampling technique would have been to match group participants to the greatest extent possible based on such variables as age, disability, and gender. The barrier to this approach was access to a sufficient pool of subjects in order to place participants into their respective group.

The small sample size can also be listed as a limitation of this study. Since the study used volunteer subjects, generating larger numbers of participants proved difficult. The small sample for the study reduced the ability to detect significant changes within each group. In addition, because of the use of a convenience sample of children in only two counties in North Carolina, results cannot be generalized to the entire population of children with developmental disabilities.

All of the participants were Special Olympic athletes but the general level of physical activity for the groups or individuals was unknown. This is a limitation of this study. However, while the participants in this study were all Special Olympic athletes (participated in at least one sport), their general level of fitness levels on the five items of the Brockport Physical Fitness Test were generally below the standards set, with the exception of the Back-Saver Sit and Reach Test. Additional measures of physical activity would have proved beneficial in establishing a productive protocol for the therapeutic aquatic exercise program.

As a general observation, the participants in this study were all classified as having autism with the exception of one individual. In a study by Borremans, Rintala, and McCubbin (2010), it was noted that children with Asperger syndrome (AS) (an autism spectrum disorder) scored significantly lower that a comparison group “on all physical fitness subtests, including balance, coordination, flexibility, muscular strength, running speed and cardio-respiratory endurance” (p. 308). It may be that children with autism perform differently on the items on the Brockport Physical Fitness Test, since the test items were normed across developmental disability groups. The fitness test measures for participants in this study were consistently lower than the standards set by the Brockport Physical Fitness Test.

Conclusion

Results of this study indicated that there were no positive gains in physical fitness for the children who participated in either the therapeutic aquatic exercise and Special Olympics group or the Special Olympics only group. The claim made by the Special Olympics Healthy Athletes program stating that Special Olympics programming is not enough to affect physical fitness levels is supported by this study. Consequently, the use of a therapeutic aquatic exercise protocol as an adjunct to Special Olympics also did not produced significant gains.

Given the results of this study, supplemental programs aimed at promoting fitness for children and youth with developmental disabilities is still a worthy endeavor. It seems essential that programs be designed to provide more physical activity geared toward increasing physical fitness levels in children with developmental disabilities. While the aquatics program used in this study, in conjunction with Special Olympics programming, did not produce significant gains in physical fitness, modification in the therapeutic aquatic protocol may generate better results.

Perhaps the key to addressing this issue is to identify those activities that the child with a disabling condition are receptive to participating and integrating that activity into a fitness strategy as a means to improve fitness measures of children with developmental disabilities. This study does demonstrate the need for additional research on alternative strategies for improving the fitness level of children with developmental disabilities as a supplement to Special Olympics participation.

While the aquatic intervention did not produce significant changes, the results do reflect the need to modify the aquatic intervention protocol. Elements including the frequency of sessions, the intensity of the aquatic sessions, and in the duration of the sessions offered need to be further evaluated in order to produce greater gains.

Other alternative, low impact strategies also need to be tested in order to respond to the need for improved fitness among persons with developmental disabilities. For instance, Tai Chi (Channer, Barrow, Barrow, Osborne, & Ives, 1996; Schaller, 1996) and Yoga (Berger & Owen, 1992) are both low impact strategies that have proven effective in improving physical fitness, flexibility, balance, and general core strength. It may be that the introduction of such low impact activities may also prove beneficial as an adjunct to Special Olympics participation.

Given the outcomes of this study, it is evident that additional supplemental exercise and physical activity programs, consistent with the recommendation of the CDC (2011) and Special Olympics (2010) are needed to improve the physical fitness of children with developmental disabilities. Efforts to continue to test these alternative strategies for improving the physical activity and fitness levels is warranted.

Table 1.

Therapeutic Aquatic Exercise Protocol (Duration: 1 hour)

Warm Up:
Walking forward (4 widths)
Walking backward (4 widths)
Side steps (4 widths)

Main Exercise:
Set #1: cardio
Leg kicks using side of pool (x30 seconds)
Run in place (x30 seconds)
Jumping Jacks (x10)
Run in place (x30 seconds)
Leg kicks using side of pool (x30 seconds)

Set #2: noodles
Noodle hops (4 widths)
Swim forward with noodles (4 widths)
Swim backward with noodles (4 widths)

Set #3: water dumbbells
Side lateral raises (2 sets/8 reps)
Front deltoid raises (2 sets/8 reps)
Repeat.

10 minute break – partner activity

Set #4: kickboards
Kickboard swim (4 lengths)
Kickboard relay races

Set #5: cardio
Leg kicks using side of pool (x30 seconds)
Run in place (x30 seconds)
Jumping Jacks (x10)
Run in place (x30 seconds)
Leg kicks using side of pool (x30 seconds)

Cool Down:
Side steps (4 widths)
Running/Walking backward (4 widths)
Walking forward (4 widths)

Five Minutes Free Time

Table 2.

Descriptive Statistics

Characteristics	Sample (M±SD)
Age	
Aquatic & SO	10.00± 1.265
SO Only	13.75± 1.035
Total	12.14± 2.214
Gender*	
Aquatic & SO	3F; 3M
SO only	2F; 6M
Total	9F; 5M

*F=Female; M =Male

Table 3.

Paired Samples T-Test Pre vs. Post - Therapeutic aquatic exercise and Special Olympics group (Mean, SD, and sig.)

	Change Score		
Test Items	Mean	Std. Dev.	Sig. (2-tailed)
16M PACER	0.167	3.600	0.914
Modified Curl-Up	1.667	4.412	0.397
Extended Arm Hang	-0.167	3.869	0.920
Flexed Arm Hang	0.000	0.258	1.000
Back-Saver Sit and Reach (Left Leg)	1.500	1.384	0.328
Back-Saver Sit and Reach (Right Leg)	1.000	1.506	0.536

Means reflect change in score from pre-test to post-test
Note:
16M PACER change is in number of laps completed
Modified Curl-Up change is in number of curl-ups performed
Extended Arm Hang change is in number of seconds hung
Flexed Arm Hang change is in number of seconds hung
Back Saver Sit and Reach change is in number of inches reached

Table 4.

Paired Samples T-Test Pre vs. Post – Special Olympics Only Group (Mean, SD, and sig.)

Test Items	Mean	Std. Dev.	Sig. (2-tailed)
16M PACER	-3.625	4.596	0.061
Modified Curl-Up	3.125	10.508	0.428
Extended Arm Hang	2.500	4.440	0.155
Flexed Arm Hang	-0.625	4.173	0.685
Back-Saver Sit and Reach (Left Leg)	-0.875	4.734	0.617
Back-Saver Sit and Reach (Right Leg)	-2.375	5.680	0.276

Means reflect change in score from pre-test to post-test
Note:
16M PACER change is in number of laps completed
Modified Curl-Up change is in number of curl-ups performed
Extended Arm Hang change is in number of seconds hung
Flexed Arm Hang change is in number of seconds hung
Back Saver Sit and Reach change is in number of inches reached

Table 5.

PACER Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of laps)	Pre Test	Post Test
Aquatic	A1	10	F	5	6	5
Aquatic	A2	9	M	N/A	12	7
Aquatic	A3	9	F	N/A	11	8
Aquatic	A4	11	M	16	3	8
Aquatic	A5	9	F	N/A	4	5
Aquatic	A6	12	M	24	6	8
SO Only	S1	15	M	45	0	1
SO Only	S2	14	M	38	3	3
SO Only	S3	15	M	45	3	2
SO Only	S4	14	F	11	5	17
SO Only	S5	12	M	24	7	16
SO Only	S6	14	M	38	14	17
SO Only	S7	14	F	11	16	17
SO Only	S8	13	M	30	12	16

Table 6.

Modified Curl-Up Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of curl-ups)	Pre Test	Post Test
Aquatic	A1	10	F	7	13	12
Aquatic	A2	9	M	N/A	20	16
Aquatic	A3	9	F	N/A	10	10
Aquatic	A4	11	M	9	20	11
Aquatic	A5	9	F	N/A	3	3
Aquatic	A6	12	M	11	5	9
SO Only	S1	15	M	14	1	0
SO Only	S2	14	M	14	20	9
SO Only	S3	15	M	14	20	37
SO Only	S4	14	F	11	23	26
SO Only	S5	12	M	11	30	27
SO Only	S6	14	M	14	75	75
SO Only	S7	14	F	11	69	50
SO Only	S8	13	M	13	20	14

Table 7.

Extended Arm Hang Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of seconds)	Pre Test	Post Test
Aquatic	A1	10	F	15	1	4
Aquatic	A2	9	M	N/A	6	1
Aquatic	A3	9	F	N/A	6	12
Aquatic	A4	11	M	23	3	1
Aquatic	A5	9	F	N/A	1	0
Aquatic	A6	12	M	23	1	1
SO Only	S1	15	M	N/A	2	3
SO Only	S2	14	M	N/A	0	0
SO Only	S3	15	M	N/A	3	2
SO Only	S4	14	F	N/A	16	17
SO Only	S5	12	M	15	6	4
SO Only	S6	14	M	N/A	30	21
SO Only	S7	14	F	N/A	4	4
SO Only	S8	13	M	N/A	30	20

Table 8.

Flexed Arm Hang Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of seconds)	Pre Test	Post Test
Aquatic	A1	10	F	N/A	1	1
Aquatic	A2	9	M	N/A	1	1
Aquatic	A3	9	F	N/A	1	0
Aquatic	A4	11	M	N/A	1	1
Aquatic	A5	9	F	N/A	0	0
Aquatic	A6	12	M	N/A	1	2
SO Only	S1	15	M	8	0	0
SO Only	S2	14	M	8	0	0
SO Only	S3	15	M	8	0	0
SO Only	S4	14	F	4	15	10
SO Only	S5	12	M	N/A	0	0
SO Only	S6	14	M	8	16	16
SO Only	S7	14	F	4	0	0
SO Only	S8	13	M	6	20	30

Table 9.

Back-Saver Sit and Reach General Standards for Children vs. Research Participants

					Right Leg		**Left Leg**	
Group	Participant	Age	Gender	Standard (in.)	Pre Test	Post Test	Pre Test	Post Test
Aquatic	A1	10	F	9	13	14	13	13
Aquatic	A2	9	M	N/A	12	12	13	11
Aquatic	A3	9	F	N/A	13	15	13	14
Aquatic	A4	11	M	8	13	11	12	11
Aquatic	A5	9	F	N/A	15	7	15	7
Aquatic	A6	12	M	8	6	7	6	7
SO Only	S1	15	M	8	17	17	16	16
SO Only	S2	14	M	8	0	15	0	12
SO Only	S3	15	M	8	11	11	12	11
SO Only	S4	14	F	10	19	16	18	15
SO Only	S5	12	M	8	14	14	14	16
SO Only	S6	14	M	8	12	18	19	17
SO Only	S7	14	F	10	10	10	11	10
SO Only	S8	13	M	8	11	12	12	12

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APPENDIX A

Extended Literature Review

To further elaborate on the research and evidence behind the measures and constructs of this study, additional research was explored. This review presents the literature pertaining to the study of an aquatic fitness program and its effects on the physical fitness of children with developmental disabilities participating in a Special Olympics sport. The review covers four major sections. Section one reviews the issues revolving around why individuals with disabilities are not participating in physical activity. Section two provides a short overview of developmental disabilities. Section three covers physical activity, exercise, and physical fitness and the benefits related to children with developmental disabilities. This section also includes an overview of the Special Olympics program. Finally, the fourth section covers the use of aquatic therapy, and its potential as a physical fitness intervention for children with developmental disabilities.

Introduction

The issues surrounding physical activity and individuals with disabilities are well founded in the literature. According to *Healthy Children 2010*, "people with disabilities are less likely to participate in sustained or vigorous exercise than people without disabilities" (Healthy People 2010, 2001). Children who are diagnosed with a chronic disease or disability are among the least active children in the nation. Johnson (2009) claims that lack of access, lack of support in the community, and the nature of the individual's disability, explain why many children with disabilities do not engage in regular physical activity. Inactivity puts these children at risk for developing serious secondary conditions such as cardiovascular disease, type II diabetes, high blood pressure, obesity, and osteoporosis. Other secondary impairments can include osteoarthritis, decreased balance, strength, fitness, endurance, flexibility, and depression (Johnson, 2009). Obesity rates are also high among persons with disabilities. One study noted that more than 75 percent of females with developmental disabilities are obese (Pitetti, Rimmer, & Fernhall, 1993). Another study concluded that in a sample of 290 people with Down syndrome, 45 percent of men and 56 percent of women had Body Mass Index (BMI) measurements categorized as "overweight" (Rubin, Rimmer, Chicoine, Braddock, & McGuire, 1998). The percentage rate for individuals with Down syndrome that are overweight is high, when compared to data on the general population. Data indicates that only 11 percent of children and adolescents ages six to 19 are overweight or obese, and only 23 percent of adults, age 20 and older, are considered obese (Healthy People 2010, 2001).

In addition, children with disabilities tend to be weaker and may fatigue earlier than their peers. They have higher metabolic, cardiorespiratory, and mechanical costs of mobility, which cause decreased exercise performance. "Strength training and endurance training are components of physical fitness that may prevent secondary disorders, lower costs of movement, and enhance quality of life for children with disabilities" (Fragala-Pinkham, Haley, Rabin, & Kharasch, 2005, p. 1183).

One way to counter the issue of overweight and obesity and the associated problems is physical activity promotion. Benefits from participation in physical activity can be physical, mental, and emotional. Sport participation and other physical activities are recommended for children with disabilities (Johnson, 2009).

Developmental Disabilities

A developmental disability, as defined by the Developmental Disabilities Assistance and Bill of Rights Act of 2000 (Public Law 106-402) is “a severe, chronic disability that is attributable to a physical or mental impairment that is likely to continue throughout the person’s life and results in functional limitation in three of more areas of life activities” (2000).

Developmental disabilities are:

1.) Manifested before the individual turns 22 years old,
2.) Likely to continue indefinitely,
3.) Reflects the individual’s need for a combination and sequence of special, interdisciplinary, or generic services, individualized supports, or other forms of assistance that are of lifelong or extended duration and are individually planned and coordinated, and
4.) Results in substantial functional limitations in three or more of the following areas of major life activity: self-care, receptive and expressive language, learning, mobility, self-direction, capacity for independent living, or economic self-sufficiency (Public Law 106-402, 2000).

Statistics show that in 1999, between 3.2 and 4.5 million individuals with developmental disabilities were living in the United States. Recent studies indicate that individuals with developmental disabilities comprise between 1.2 and 1.65 percent of the United States population (Public Law 106-402, 2000).

There are four different types of developmental disabilities: (1) nervous system disabilities, (2) sensory related disabilities, (3) metabolic disorders, and (4) degenerative disorders. Each type of developmental disability has its own characteristics and impacts on how it affects the body.

Nervous system disabilities affect how the brain, spinal cord and nervous system function. This can have a major impact on intelligence and learning. Nervous system disabilities can also cause problems such as behavioral disorders, speech or language difficulties, convulsions, and movement disorders. Some of the most common nervous system disabilities include: Intellectual and Developmental Disabilities (IDDs) and Autism Spectrum Disorders (NICHD, 2010). The term IDDs describes a certain range of scores on an IQ (intelligence quotient) test. IDDs can result from a number of different conditions, including Down syndrome and Fragile X syndrome among others (NICHD, 2010).

Sensory-related disabilities can cause vision, hearing and sight problems. Examples of sensory-related disabilities are children with congenital rubella, Williams' syndrome and Fragile X syndrome. Children who have congenital rubella commonly develop cataracts of the eyes, as well deafness. Children with Williams' syndrome have trouble seeing spatial relationships between objects around them, and children with Fragile X syndrome are commonly sensitive to loud noises (NICHD, 2010).

Metabolic disorders affect a person's metabolism. Metabolism is how a person's body builds up, breaks down, and otherwise processes the resources it needs to function properly. Phenylketonuria (PKU) and hypothyroidism are two commonly known metabolic disorders. Left untreated both of these conditions can cause IDDs (NICHD, 2010).

Rather than at birth, degenerative disorders are normally not found until an older age. The child will appear normal at birth and slowly lose abilities and functions due to a degenerative disorder. Degenerative disorders can cause physical, mental, and sensory problems, depending on the specific defect. Rett syndrome is an example of a degenerative birth defect that usually affects girls and is caused by a specific genetic abnormality. Other degenerative disorders include but are not limited to Osteogenesis Imperfecta, Duchenne Muscular Dystrophy, and Spinal Muscular Atrophy.

Children with disabilities, specifically developmental disabilities, encompass approximately 17 percent of the population under the age of 18, and reflect significantly lower levels of fitness than the general population (Centers for Disease Control and Prevention, 2004). It is essential therefore, to provide more opportunities for physical activity.

Physical Activity, Exercise, and Physical Fitness

According to Huang, Macera, et al. (1998), physical activity has been shown to positively affect physical functioning and prevent functional limitation, the inability to carry out normal daily tasks and roles. Participating in physical activity can reduce the incidence of chronic diseases, the major cause of functional limitation, and maintain the physiologic capacity to enable normal functional performance. "Physical activity is associated with optimal function and low incidence of functional limitation among relatively healthy persons and among those with chronic conditions" (Haung et al., 1998, p. 1430).

For most people who are not professionals in the health and fitness field, physical activity, exercise, and physical fitness are terms that are often used interchangeably. However, they are three different terms with three very different meanings.

Physical activity is defined as "any bodily movement produced by skeletal muscles that result in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p. 126). Physical activities can be categorized into the four areas of occupational, sports, conditioning, and household.

Exercise is a subset of physical activity (Caspersen et al., 1985). Although physical activity and exercise are similar (both involve bodily movements performed by working muscles resulting in the expenditure of calories), exercise, which is planned, structured, and repetitive, focuses on improving or maintaining physical fitness. A person who plays basketball or jogs for a structured time frame is exercising. A person who mows the lawn or climbs a flight of stairs, or performs housework is performing physical activity. "The major difference, however, is that structured exercise usually involves a greater increase in physical fitness than general physical activity because it is performed at a higher intensity level. Nonetheless, both types of movement are needed during the day to confer optimum health benefits" (Rimmer, 2009, para. 3).

According to Pate (1988), physical fitness is defined as "a state characterized by an ability to perform daily activities with vigor, as well as the demonstration of traits and capacities associated with low risk of premature development of the hypokinetic diseases, including such diseases as obesity, type II diabetes, coronary heart disease and osteoporosis" (p. 177). Physical fitness includes three primary components: (1) cardiovascular endurance, (2) muscle strength and endurance, and (3) flexibility (Rimmer, 2009). Each component is attained by varying types of programs and activities.

There are many ways for children with developmental disabilities to increase their physical fitness levels. This can include participation in a sports program or taking part in a fitness class that addresses their specific needs.

Special Olympics

"Let me win, but if cannot win, let me be brave in the attempt." This quote is the oath each athlete takes before participating in a Special Olympics competition or event. "The mission of Special Olympics is to provide year-round sports training and athletic competition in a variety of Olympic-type sports for children and adults with intellectual disabilities, giving them continuing opportunities to develop physical fitness, demonstrate courage, experience joy and participate in a sharing of gifts, skills and friendship with their families, other Special Olympics athletes and the community" (Special Olympics, 2010, para. 1).

The purpose of Special Olympics is to:

1.) Promote a healthy competitive spirit,
2.) Develop leadership and self-esteem,
3.) Facilitate physiologic health through improvement in the strength and endurance of the neuromuscular and cardiovascular systems,

4.) Nurture positive mental attitudes, and
5.) Encourage a lifelong habit of physical activity as one good way of improving the quality of life (Birrer, 2004, p. 777).

The Special Olympics program offers athletes an opportunity to participate in 30 different sports ranging from gymnastics to track and field, alpine skiing to cricket. All 50 states have a Special Olympics program and there are programs in six of the seven continents. Once an athlete becomes involved in a Special Olympics program they participate for an average of 11 years and 14 percent of athletes are involved for over 20 years. During the course of their participation, athletes will on average play two sports, and 35 percent of athletes will partake in three or more sports (Harada & Siperstein, 2009). There are many reasons as to why an individual decides to participate in a Special Olympics sport including receiving ribbons and medals, playing with other people on the team, doing something they are good at, having fun, and travelling to new places. According to a study done by Shapiro (2003) on the motives of participation for Special Olympics athletes, getting exercise and being physically fit ranked as the third highest reason for participation.

In order to begin to combat the increasing problem of decreased physical fitness in these athletes, Special Olympics designed a program called *Special Olympics Healthy Athletes.* Among the athletes participating in this program 86 percent had BMI measurements that were categorized as overweight or obese. This program, which lasted for eight weeks, found improvements in body weight, abdominal fat, flexibility, aerobic fitness, and muscular strength and endurance (Special Olympics Healthy Athletes, 2005). Although this program continues to be successful, it is imperative that other efforts to combat decreased physical fitness among individuals with developmental disabilities be developed.

Physical Fitness and Developmental Disabilities Research

For children with developmental disabilities, regular fitness is encouraged in order to prevent diseases and promote physical well-being. Several researchers have examined the issue of physical activity on fitness measures for individuals with developmental disabilities. Authors such as Blundell, Shepard, Dean, and Adams (2003), Darrah, Wessel, Nearingburg, and O'Connor (1999), Fragala-Pinkham, Haley, Rabin, and Kharasch (2005), Fragala-Pinkham, Haley, and Goodgold, (2006), and Dyer (1994) have all addressed the topic of fitness for children with developmental disabilities.

According to Fragala-Pinkham et al., as compared to a home based fitness intervention, group fitness classes designed to meet the needs of children with developmental disabilities may produce significant changes in strength, endurance, self-perception, and functional an gross motor abilities however, factors such as physical therapy, maturation, or learning effect due to repetition of outcome measures may have also had a part in the participants' change.

Authors	Fragala-Pinkham, M., Haley, S., Rabin, J., & Kharasch, V. (2005)
Title	*A Fitness Program for Children with Disabilities*
Objective	(1) To describe a 14-week group exercise program followed by a 12-week home exercise program for children 5-9 years of age with a variety of developmental disabilities, and (2) to provide information about the safety and feasibility of a group fitness program including strength training and conditioning for children with developmental disabilities.
Methods	Nine children with physical or other developmental disabilities between the ages of 5-9 volunteered to participate in a fitness program. All children had "decreased fitness," as reported by their parents, and were not enrolled in any current community sports programs during that time. Initial measurements were completed over a 2 month period prior to the start of the first intervention. The first intervention was a group exercise program for 14 weeks, two times a week. The second intervention was a 12-week home based fitness program using videotaped and written home exercises. Measurements were taken again after the first intervention and after the second intervention.
Results	After the group exercise intervention, all of the children made improvements in two or more of the measured outcomes. Minimal changes were found after the 12-week home exercise program.
Conclusion	Changes in strength, endurance, self-perception, and functional and gross motor

	abilities may have been due to participation in a 14-week group fitness class, however, factors such as physical therapy, maturation, or learning effect, due to repetition of outcome measures, may have also had a part in the participants' change.

Fitness programs for children with disabilities can sometimes be difficult to create. "Adaptive exercise equipment, fitness assessments specifically designed for children with disabilities, behavioral management interventions, and medical precautions may be required for safe and effective participation" (Fragala-Pinkham, Haley, & Goodgold, 2006, p. 159). However, with the right mix of instructors, facilities, and equipment significant improvements may be observed.

Authors	Fragala-Pinkham, M., Haley, S., & Goodgold, S. (2006)
Title	*Evaluation of a Community-Based Group Fitness Program for Children With Disabilities*
Objective	(1) To expand the scope of current knowledge on comprehensive fitness programs for children with disabilities, and (2) to evaluate the feasibility, safety, and effectiveness of shifting a hospital-based fitness program for children with neuromuscular and developmental disabilities to a community setting.
Methods	Twenty-eight children volunteered to participate in a community-based fitness program, held twice a week for 16 weeks. A pretest-posttest design was used. Outcomes measured included isometric muscle strength of the knee extensors, hip abductors, and ankle plantarflexors, walking energy expenditure, functional mobility, and fitness.
Results	Significant improvements were found for all clinical outcomes.
Conclusion	A community-based group fitness program for school-aged children with disabilities was feasible and safe to implement and may serve as a template for physical therapists to use when partnering with community centers.

Many researchers choose to study the effects of physical activity on specific sub-populations of developmental disabilities including Down syndrome and cerebral palsy. Because of their higher risk of chronic diseases that can be worsened by obesity and a sedentary lifestyle, physical activity must become part of a child with Down syndrome's daily life.

Authors	Lewis, C., & Fragala-Pinkham, M. (2005).
Title	*Effects of Aerobic Conditioning and Strength Training on a Child with Down*

	Syndrome: A Case Study
Objective	(1) To examine the effects of a six-week home treatment program for a 10.5-year-old girl with Down syndrome
Methods	In this single-subject case study, a 10.5-year-old female was assessed pre and post intervention in the following areas: cardiovascular function, body dimensions, flexibility, gross motor skills, anaerobic power test, and muscle strength and endurance. To monitor progress she attended a physical therapy consultation once a week. The home based program initially included four to five days of exercise a week, but increased to six days a week. By the third week, the subject alternated three days a week of aerobic activities with three days a week of strength training.
Results	Post intervention the subject showed significantly lower heart and respiratory rates. However, her VO_2 did not significantly change. Body mass index did not change. Her flexibility was within normal limits pre intervention and was maintained post intervention. Significant gains in gross motor skills posttraining were observed. A 60% increase in anaerobic power was also obtained. Strength gains were found in all measurements for the trunk and upper and lower limbs.
Conclusion	To achieve cardiovascular benefits for children with Down syndrome, a combination program of aerobic conditioning and strength training is more effective than aerobic conditioning alone. In order for the program to be effective in individuals with Down syndrome, the participant must exercise at a moderate to high intensity for a minimum of 30 minutes, five to six days per week. Because muscle strength and VO_2 are highly correlated in individuals with Down syndrome, combined aerobic and strength training protocols may be necessary for the improvement of cardiovascular function.

Cerebral Palsy (CP) is another developmental disability where persons with this diagnosis can experience decreased range of motion, muscle strength, and cardiovascular endurance as children enter adolescence. It has been found that muscle strength can be improved in adolescents with CP who participate in a regular community-based exercise program that includes aerobics, weight training, and flexibility exercises.

Authors	Darrah, J., Wessel, J., Nearingburg, P., & O’Connor, M. (1999).
Title	*Evaluation of a Community Fitness Program for Adolescents with Cerebral Palsy*
Objective	(1) To develop and evaluate the effects of a community based conditioning program for adolescents with CP
Methods	Three pretests before the training program, one posttest immediately after, and then one post test ten weeks following the training program, measured the following outcomes: overall exercise efficiency, isometric strength of specific muscle groups, flexibility of specific joints, and heart rate during a standardized submaximal exercise. Twenty-three people ages 11-23, with a diagnosis of CP participated in a ten week training program three times a week.

Results	Strength values increased significantly between the pretest and posttest, and remained unchanged at the 10 week follow-up. A significant increase in flexibility scores occurred between pretests 2 and 3 and was maintained through both posttests. Energy expenditure index rates and heart rate did not change significantly at anytime.
Conclusion	Muscle strength can be improved in adolescents with CP who participate in a regular community-based exercise program that includes aerobics, weight training, and flexibility exercises. ROM measurements were too variable to detect pretest and posttest changes, and cardiovascular efficiency did not change from participation in this program.

Aquatic Therapy

Aquatic therapy is a method of treatment that is "conducted in an inherently freeing environment" (p. 65) that can provide not only physical benefits but psychological and leisure ones as well (Broach & Dattilo, 2000). Many healthcare professionals including recreational therapists, physical therapists, occupational therapists, exercise physiologists, and kinesiotherapists use aquatic therapy as a fun, exciting way to rehabilitate their patients (Jake, 2008). Patients who have participated in aquatic therapy have shown both physiological benefits and psychological benefits. These benefits are derived from opportunities afforded by water, a unique treatment setting.

The availability of therapy pools in the community is becoming more widespread. Young children with developmental disabilities are increasingly being referred to centers that can provide aquatic therapy. In an outpatient setting, an aquatic therapist can treat children with neuromuscular and related disabilities using various neurophysiological techniques and therapeutic exercises (Martin, 1983).

Aquatic Therapy and Developmental Disabilities Research

According to Hutzler, Chacham, Bergman, and Szeinberg (1998) aquatic therapy has shown many other benefits for children with developmental disabilities including enabling movement when the neuromuscular system is incapable of moving against gravity, increasing range of motion, decreasing spasticity and other involuntary movements, and improving coordination, respiration and other related functions.

Authors	Hutzler, Y., Chacham, A., Bergman, U., & Szeinberg, A. (1998)
Title	*Effects of a Movement and Swimming Program on Vital Capacity and Water Orientation Skills of Children with Cerebral Palsy*
Objective	(1) To evaluate the effect of a 6-month movement and swimming program on the respiratory function of kindergarten children with CP in contrast to a control group, (2) to evaluate the performance of water orientation skills in children with CP before and after a training program, and (3) to describe the relation between water orientation skills and vital capacity.
Methods	A sample of 46 children, ages 5-7, were categorized into treatment and control groups. Children in the treatment group participated in a six-month movement and swimming exercise intervention program. The children in the control group did not participate in the aquatic program.
Results	Both groups experienced improvement in their vital capacity, however, results suggest a significantly superior increase in respiratory function of the treatment group compared with the control group.
Conclusion	A movement and swimming program seems to be beneficial in improving respiratory muscle function and modifying learned postural responses that prevent efficient breathing in children with CP.

Low-impact exercise, such as aquatic therapy, can be a great option for children with disabilities, because joint loading forces are greatly reduced and at the same time the water provides resistance that may be used to increase muscle strength and aerobic capacity. The benefits are suggested in a study done by Fragala-Pinkham, Haley, and O'Neil (2008) on a group aquatic aerobic exercise for children with disabilities

Authors	Fragala-Pinkham, M., Haley, S. M., & O'Neil, M. E. (2008)
Title	*Group Aquatic Aerobic Exercise for Children with Disabilities*
Objective	(1) To evaluate the effectiveness and safety of a group aquatic aerobic exercise program for children with disabilities on cardiorespiratory endurance, and (2) to evaluate the effects of the program on muscle strength and motor skills.
Methods	Sixteen children, ages 6-11, participated in a twice per week aquatic aerobic exercise program for 14 weeks. Cardiorespiratory endurance was measured by the half-mile walk/run test. Muscle strength was measured using the handheld Chatillon dynamometer and abdominal muscular strength and endurance was measured using a modified curl-up as specified by the Brockport Fitness Test

	Manual. Motor skills were measured by the Multidimensional Pediatric Evaluation of Disability Inventory (M-PEDI). Functional Skills Mobility Scale, and the Floor to Stand test was also used. Heart rate was measured using Polar HR monitors throughout the pool sessions. All measurements were taken before the intervention was initiated and at the end of the 14 week intervention period.
Results	The results of this study found that cardiorespiratory endurance significantly improved as demonstrated by improved time on the half-mile walk/run. Improvement in exercise capacity was also noted by an increased ability to exercise for longer periods of time in their target HR zone.
Conclusion	The conclusion was that group aquatic exercise was a fun alternative to land based activity for improving cardiorespiratory endurance in children with disabilities.

Yilmaz, et al. (2009) completed a study on the effects of water exercises and swimming on physical fitness of children with intellectual disabilities. Although research has been completed on the effects of aquatic exercises on children without disabilities, there has been no research on children with intellectual disabilities prior to the completion of this study.

Authors	Yilmaz, I., Ergun, N., Ferman, K., Agbuga, B., Zorba, E., & Cimen, Z. (2009)
Title	*The Effects of Water Exercises and Swimming on Physical Fitness of Children with Mental Retardation*
Objective	To evaluate the effects of a 10-week exercise and swimming program on physical fitness of children with mental retardation (MR).
Methods	Sixteen children with a mean age of 12.22 were recruited for this study. All subjects participated in a 10-week water exercise and swimming program, for two times a week, 40 minutes each session. The study measured six dependent variables of physical fitness: (1) 25-yard dash, (2) bent arm hang, (3) leg lift, (4) thrusts, (5) static balance test, and (6) 300 yard run-walk.
Results	The results of this study showed that children with MR improved significantly in all six dependent variables of physical fitness.
Conclusion	"Considering the limitations and sedentary lifestyles of all children with MR, aquatic exercises can be a good way of developing physical fitness and motor skill development for children with MR" (p. 108).

In addition to research on the effects of aquatic therapy on children with developmental disabilities, some studies choose to focus on specific developmental disabilities, like autism spectrum disorder.

Authors	Pan, C. (2010)
Title	*Effects of Water Exercise Swimming Program on Aquatic Skills and Social Behaviors in Children with Autism Spectrum Disorders*

Objective	To determine the effectiveness of a 10 week water exercise swimming program on the aquatic skills and social behaviors of 16 boys with autism spectrum disorders.
Methods	Participants for this were identified as meeting the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 1994) criteria for autism. Diagnoses included mild or high-functioning autism (*n* = 8) and Asperger syndrome (*n* = 8). Each participant was assessed three times, once prior to treatment to serve as the baseline (T1), a second time after 10 weeks of the water exercise swimming programs or regular treatment/activity (T2), and a third time after another 10 weeks (T3). The HAAR checklist, which is based off of the Halliwick method, was used to assess each participant's aquatic skills.
Results	Following the initial phase of treatment, significant improvements in social skills were seen by group A. After phase two, social improvements were seen in group B, while group A's improvements were maintained. Results also indicated that improvements in aquatic skills were gained by both groups after participation in the water swimming exercise program.
Conclusion	"A 10 week WESP with an embedded social behavior component improves aquatic skills and holds potential for social skill improvements. The persistence of effects 10 weeks following WESP suggests a positive response to the treatment. Results from this study indicate that the environment provided by WESP enables individuals to develop physical skills within this intervention process and possibly enhances their behavioral and social skills in the future" (p. 26).

Authors	Yilmaz, I., Yanardag, M., Birkan, B., & Bumin, G. (2004)
Title	*Effects of Swimming Training on Physical Fitness and Water Orientation in Autism*
Objective	To determine the effects of water exercises and swimming on motor performance and physical fitness, and to observe the behavior of an autistic subject as he becomes familiar with the pool, and to observe the development of beginner swimming skills in children with autism.
Methods	Subject was a 9-year-old boy with autism. The child was given six physical fitness tests, as well as, completed the aquatic orientation checklist prior to and after completing the swimming program. The Halliwick Method was used for hydrotherapy application. The swimming program lasted 10 weeks, three times a week, for 60 minute sessions.
Results	After 10 weeks, balance, speed, agility, power, hand grip, upper and lower extremity muscle strength, flexibility, and cardiorespiratory endurance all increased. After the swimming program the amount of stereotypical autistic movements also decreased.
Conclusion	Swimming training is effective for development of physical fitness and water orientation in autistic children.

Research that suggests that exercise programs like those outlined above can improve the fitness levels of children with developmental disabilities. However, without proper guidance children with disabilities are at risk for injuries from land based strength training and aerobic exercise programs (Fragala-Pinkham et al., 2008). In addition, children who have difficulty with motor skills can be more successful in the pool, as compared to land, due to the combination of weightlessness and the opportunity to practice different movement patterns without the fear of injury (Prupas et al., 2006).

APPENDIX B

Rationale for the Use of Therapeutic Aquatic Exercise

Therapeutic aquatic exercise is simply defined as the use of aquatic exercises designed to aid in the rehabilitation of various disabilities and conditions (Bates & Hanson, 1996). The use of swimming and exercise activities in the water has benefits that are well documented in the literature (Broach & Datillo, 1996; Campion, 1985; Davis & Harrison, 1988). The ultimate goal of therapeutic aquatic exercise is to "prevent dysfunction and aid in the development, improvement, restoration, or maintenance of normal function including muscular strength and endurance, flexibility and mobility, relaxation, coordination, and at the appropriate time, cardiovascular endurance" (Bates & Hanson, 1996, p. 40).

The Principles and Properties of Water

For individuals with disabilities the therapeutic properties of water create "an environment for exercise which is more conducive to achieving treatment goals than exercise conducted on land" (Broach & Datillo, 1996, p. 213). Additionally, therapeutic aquatic exercise may improve the functioning of the major muscle groups without the impact from land based physical exercise" (Broach & Datillo, 1996). In order for therapeutic aquatic exercise programs to be successful sessions two factors must be addressed: the body's physiologic response to being immersed in water and the physical properties of water (Bates & Hanson, 1996). Defining properties of water that facilitate effective outcomes through therapeutic aquatic exercise include relative density, buoyancy, hydrostatic pressure, temperature, and turbulence.

Relative Density.

Relative density, also known as specific gravity, is the property of water that determines whether an object will float. The relative density is "the ratio of the weight of the object to the weight of an equal volume of water. If this value is greater than one, the object will sink; if it is less than one, the object will float. If the value is exactly one, the object will float just below the surface of the water" (Bates & Hanson, 1996, p. 21). Due to the specific gravities of fat, bone, and lean muscle (0.8, 1.5 to 2.0, and 1.0, respectively), lean people tend to sink while obese people tend to float. Additionally, women generally have more body fat than men, and consequently tend to float better (Bates & Hanson, 1996).

Buoyancy.

Buoyancy is best explained through Archimedes' principle which states that, "when a body is fully or partially submerged in a fluid at rest, it experiences an upward thrust equal to the weight of the fluid displaced" (Bates & Hanson, 1996, p. 22). Buoyancy can be used in three different ways: assistive, resistive, or supportive. It assists any movement toward the surface of the water and resists movement away from the surface, as well as supporting horizontal movements when buoyancy equals the force of gravity (Bates & Hanson, 1996). The use of floatation devices can enhance the three qualities of buoyancy, particularly when exercising the arms and legs.

Reduction of weight bearing forces is one of the main advantages of therapeutic aquatic exercise. Because of buoyancy, individuals exercising in the water "feel lighter, move more easily, and feel less weight on their joints" (Bates & Hanson, 1996, p. 24). At different depths of water the percentage of weight displaced increases or decreases (Broach & Datillo, 2000).

Hydrostatic Pressure.

Hydrostatic pressure is the fluid pressure exerted on surfaces that are immersed in a body of fluid. Pascal's Law states that the pressure is equally exerted on all surfaces at a given depth. Due the hydrostatic pressure of water on the chest wall, participants with a low vital capacity (the maximum amount of air that can be exhaled after a maximum inhalation) may have difficulty breathing. Conversely, hydrostatic pressure can reduce unnecessary swelling in lower portions of the body, as well as help stabilize weak joints (Bates & Hanson, 1996; Broach & Datillo, 2000). .

Temperature.

According to Bates and Hanson (1996), the temperature of the water, as well as the amount of heat produced by the body while exercising, must be considered when determining a comfortable temperature at which to exercise. "Vigorous exercise performed in warm water (> 91°F) results in an increase in core temperature and premature fatigue" (p. 28). The use of vigorous exercise in cold water (< 65°F) drops an individual's core temperature and causes an inability to contract muscles. Therefore, the ideal temperature for vigorous exercise is 82° to 86°F. .

Turbulence.

"Turbulence creates uneven patterns of water movement that may establish patterns of low pressure areas called *eddies* following in the wake of an object moving through a fluid" (Broach & Datillo, 2000, p. 79). When speed increases, eddies are formed creating a suction effect that pulls a body through the water. Reversing the movement increases turbulence and resistance.

During therapeutic aquatic exercise sessions, the eddies are used by the therapist to offer assistance in swimming or ambulating by walking in front of the participant. Improvements in balance can be established through the use of turbulence (Broach & Datillo, 2000).

The Physiologic Benefits of Exercising in Water

The literature supports the use of exercising in water to produce benefits that may have the potential to enhance the quality of life for people with disabilities. Physiologic benefits of immersion and movement in the water have been well documented in the literature (Broach & Datillo, 1996; Campion, 1985; Davis & Harrison, 1988).

Exercise in an aquatic environment can produce strength and endurance gains that may not be possible during land based exercise. The properties of water provide for an increase in resistance to movement and allow the joints to move with greater ease (Bates & Hanson, 1996). When body parts are submerged in water they encounter resistance in all directions of movement. Therefore, movement in water requires greater energy expenditure than movement on land.

Water exercise can also improve respiratory muscles and vital capacity. In chest deep water, the increase of the hydrostatic pressure on the chest walls makes breathing more difficult. By utilizing aerobic oriented aquatic activities, an increase in respiration is possible. In addition, techniques such as blowing bubbles can be used to train the breathing aspect of respiration for patients who have respiratory problems (Bates & Hanson, 1996).

Skinner and Thompson (1989) documented several additional physical benefits of movement through water including relaxation, relief of pain and muscle spasms, maintained or increased range of motion in joints, and reeducation of paralyzed muscles. In addition, the water stimulates sites where the body takes in information. For individuals with disabilities who require sensory stimulation, aquatics can serve as an important adjunct to other therapy (Lepore, Gayle, & Stevens, 2007).

Finally, a major advantage of therapeutic aquatic exercise is that “it may enhance functional ability that encompasses all areas of life and helps to develop a life-long leisure activity that can be enjoyed with other people" (Broach and Datillo, 1996, p. 224). Keeping in mind the individuals' condition, strengths, and weaknesses, using an aquatic environment as opposed to a land based one while exercising can substantially improve the participant's quality of life.

APPENDIX C

Instrumentation: Brockport Physical Fitness Test (BPFT)

The Brockport Physical Fitness Test (BPFT) is a battery containing 27 different test items. Depending on the disability of the child, generally only 4 to 6 test items are administered to a particular individual. The developers of the BPFT (Winnick & Short, 1999) have provided guidelines for administration of the test in *The Brockport Physical Fitness Test Manual.*

For the purposes of the study, five elements were administered. These included the 16 Meter PACER test, the Modified Curl-up, the Extended arm Hang, the Flexed Arm Hang, and the Back-Saver Sit and Reach. The test manual offers general guidelines for administration and specific steps for administration. The following are specific instructions from, *The Brockport Physical Fitness Test Manual.*

16-M PACER

Equipment. CD player with adequate volume, the PACER audio CD, measuring tape, marker cones, pencil, and score sheets are required.

Scoring and trials. One test trial is given. The individual's score is the number of completed laps.

Test modifications. Be sure that children with intellectual disabilities understand how to perform the test. It is acceptable to take whatever time is necessary to ensure that participants learn the test. Because motivation is critical, at least one person should assume the responsibility of providing continual positive reinforcement to runners as they perform the test. Children with intellectual disabilities often need to run with a tester or aide. However, assistants must not pull or push runners or give any other physical advantage to the runner.

Administration. The 16-m PACER requires the participants to run as long as possible back and forth across a 16-m distance at a specified pace, which gets faster each minute. This test is run on a flat non-slippery surface. Participants run across the area to a line by the time that a beep from a CD sounds. At the sound of the beep, they turn around and run back to the other end. If a participant reaches the line before the beep, he or she must wait for the beep before running in the other direction. Participants continue in this manner until they can no longer reach the line before the beep sounds. Participants not reaching the line when the beep sounds are given two more beeps to regain the pace before being withdrawn. In attempting to catch up, the entire 16-m lap must be completed.

Other administration suggestions.

- Mark the 16-m distance with marker cones and a tape or chalk line at each end.
- Before test day, participants should be allowed to at least two practice sessions. Allow participants to listen to several minutes of the CD before they perform the test so that they know what to expect.
- The test CD contains 21 levels (21 minutes). The CD allows 9 seconds to run the distance during the first minute. The pace then increases by approximately ½ second each following minute.
- Single beeps indicate the end of a lap. Triple beeps at the end of each minute indicate an increase in speed. Participants should be alerted that the speed will increase. Caution participants to not begin too fast: the beginning speed is very slow.
- Volunteers can assist in recording scores.
- A whistle corresponding to beeps on the CD can be used if participants are unable to hear beeps from the CD player (Winnick & Short, 1999, pp. 74-75).

Modified Curl-Ups

Equipment. A gym mat is required.

Scoring and trials. One trial is administered. An individual's score is the number of curl-ups performed correctly. On curl-up is counted for every return to a supine position on the mat. Curl-ups should not be counted if the feet completely leave the floor at any time during the movement or if the participant does not reach the required distance, does not return to the start position, or performs the curl-up in any other incorrect manner.

Test modifications. It is acceptable to take whatever time is needed to ensure that the children know how to perform the test. Motivation is critical; therefore continual positive reinforcement should be provided throughout testing.

Administration. In the curl-up test, participants complete as many curl-ups as possible, up to a maximum of 75, at a cadence of one curl every three seconds. The participant starts by lying in a supine position on the mat. The knees are bent at an angle of approximately 140°, with the feet flat on the floor and the legs slightly apart. The hands are placed on the front of the thighs. From the starting position, the participant curls up, while the hands slide along the thighs until the fingertips contact the patellae. The participant then returns to the starting position. The administrator should call the cadence (about one curl every three seconds). The participant continues without pausing until the pace cannot be maintained or until 75 repetitions have been completed.

Other administration suggestions.

- Encourage a slow curling of the upper spine during the curl-up.
- Encourage steady, controlled, and continuous movement (Winnick & Short, 1999, pp. 88-91).

Extended Arm Hang

Equipment. This test item requires an adjustable bar about 1.5 in. in diameter at a height enabling performance without touching the support surface. The surface should be no more than one to two feet below the feet while the participant is in hanging position. A gym mat should be placed under the bar. A stopwatch is also required.

Scoring and trials. One trial is permitted for each participant. The score is the elapsed time, in seconds, from the start of a free hang to the time that the fingers leave the bar.

Test modifications. Individuals with disabilities must be provided an opportunity to learn and experience the test item before scores are recorded for testing purposes.

Administration. In this test, the participant hangs from a bar or similar hanging apparatus for as long as possible, up to 40 seconds. The participants begins by grasping the bar using an overhand or pronated grip (knuckles toward the face). The thumb should be wrapped around the bar. The participant may jump to this position, be lifted to it, or move to it from a chair. The participant must assume a fully extended position with feet clear off the floor throughout the test. Elbows and knees must not be bent. The participant can be steadied so that he or she does not sway.

Other administration suggestions.

- Be sure that the bar and participant's hands are dry.
- Constant encouragement throughout the test is extremely important.
- Because some children may be afraid of falling, it is important to keep them as close to the floor or ground as possible. Gently steady youngsters, and assure them that they will be assisted if they lose their grip (Winnick & Short, 1999, pp. 93-95).

Flexed Arm Hang

Equipment. This test item requires a pull-up bar about 1.5 inches in diameter at a height exceeding the height of the participant, preferably no more than three feet and no less than 1.5 feet above the participants standing height. A gym mat should be placed under the bar. A stopwatch is required.

Scoring and trials. Each participant receives one trial. The tester records the length of time that the participant can maintain the flexed arm position. Timing stops when the head tilts back or the chin contacts or drops below the bar.

Test modifications. Individuals with disabilities must be provided an opportunity to learn and experience the test item before scores are recorded for testing purposes.

Administration. In this test, the participant attempts to maintain a flexed arm position while hanging from a bar for as long as possible. The participant should grasp the bar with an overhand grip and be assisted to a position where the body is close to the bar and the chin is clearly over, but not touching, the bar. The participant attempts to hold this position for as long as possible. The body must not swing, the knees must not be bent, and the legs must not kick during the performance of the task.

Other administration suggestions.

- A spotter can place an arm across the participant's thighs to restrict unwanted movements.
- Be sure participants understand how to perform the test before taking a score. Provide sufficient time for participants to learn the activity (Winnick & Short, 1999, pp. 95-96).

Back-Saver Sit and Reach

Equipment. This measurement is best taken using a flexibility testing apparatus approximately 12 inches high and 12 inches wide. A measuring scale is placed on top of the apparatus with the zero end of the ruler nearest the participant and the 9-inches mark even with the vertical surface against which the foot rests. The grid on the box should range from zero to at least 16 inches.

Scoring and trials. One trial (four stretches, holding the last) for each leg is given for this test. The tester records to the nearest whole unit the number of inches reached in the last attempt on each side.

Test modifications. Subjects with intellectual disabilities should be given sufficient practice time to become completely familiar with the testing procedure. They should not be encouraged to exceed the recommended criterion-referenced standards for this test item.

Administration. The object of this test is to reach across a sit-and-reach box while keeping one leg straight. The participant begins the test by removing his or her shoes and sitting down at the test apparatus. One leg is fully extended with the foot flat against the end of the testing instrument. The other knee is bent, with the sole of the foot flat on the floor 2 to 3 inches to the side of the straight knee. The arms are extended forward over the measuring scale with the hands palms down, one on top of the other. The participant reaches directly forward with both hands, along the scale four times and holds the position of the fourth reach for at least one second. After measuring one side, the participant can allow the bent knee to move to the side if necessary as the body moves by it.

Other administration suggestions.

- The knee of the extended leg must remain straight. The tester should place one hand on the straightened leg to assist proper positioning.
- The participant's hands should reach forward evenly, and the shoulders should be square to the test apparatus.
- Hips must remain square to the box. Do not allow participants to turn their hips away from the box as they reach.
- Require participants to stretch the hamstrings and lower back as a warm up before testing.
- Because motivation is an important factor, participants should receive continual encouragement and positive reinforcement during the testing process.
- Emphasize a gradual reach forward. Bobbing or jerking movements forward should not be permitted (Winnick & Short, 1999, pp. 113-116).

APPENDIX D

Aquatic Intervention

The aquatic intervention protocol was adapted from Yilmaz et al.'s (2009) study on the effects of water exercises and swimming on physical fitness of children with mental retardation. The strategy includes warm up, exercise routines, through cool down exercises. Table 1 reflects the protocol used in the aquatic intervention protocol employed.

Table 1.

Therapeutic Aquatic Exercise Protocol (Duration: 1 hour)

Warm Up:
- Walking forward (4 widths)
- Walking backward (4 widths)
- Side steps (4 widths)

Main Exercise:

Set #1: cardio
- Leg kicks using side of pool (x30 seconds)
- Run in place (x30 seconds)
- Jumping Jacks (x10)
- Run in place (x30 seconds)
- Leg kicks using side of pool (x30 seconds)

Set #2: noodles
- Noodle hops (4 widths)
- Swim forward with noodles (4 widths)
- Swim backward with noodles (4 widths)

Set #3: water dumbbells
- Side lateral raises (2 sets/8 reps)
- Front deltoid raises (2 sets/8 reps)
- Repeat.

10 minute break – partner activity

Set #4: kickboards
- Kickboard swim (4 lengths)
- Kickboard relay races

Set #5: cardio
- Leg kicks using side of pool (x30 seconds)
- Run in place (x30 seconds)
- Jumping Jacks (x10)
- Run in place (x30 seconds)
- Leg kicks using side of pool (x30 seconds)

Cool Down:
- Side steps (4 widths)
- Running/Walking backward (4 widths)
- Walking forward (4 widths)

Five Minutes Free Time

APPENDIX E

Specific Standards

To offer context to the measures generated by the aquatic intervention and Special Olympics group and the Special Olympics (SO) Only group, descriptive measures are offered as compared to specific standards generated by the Brockport Physical Fitness Test (BPFT). The data was not tested but offered a visual comparison between trial measures and BPFT proposed norms.

Table 5.

PACER Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of laps)	Pre Test	Post Test
Aquatic	A1	10	F	5	6	5
Aquatic	A2	9	M	N/A	12	7
Aquatic	A3	9	F	N/A	11	8
Aquatic	A4	11	M	16	3	8
Aquatic	A5	9	F	N/A	4	5
Aquatic	A6	12	M	24	6	8
SO Only	S1	15	M	45	0	1
SO Only	S2	14	M	38	3	3
SO Only	S3	15	M	45	3	2
SO Only	S4	14	F	11	5	17
SO Only	S5	12	M	24	7	16
SO Only	S6	14	M	38	14	17
SO Only	S7	14	F	11	16	17
SO Only	S8	13	M	30	12	16

Table 6.

Modified Curl-Up Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of curl-ups)	Pre Test	Post Test
Aquatic	A1	10	F	7	13	12
Aquatic	A2	9	M	N/A	20	16
Aquatic	A3	9	F	N/A	10	10
Aquatic	A4	11	M	9	20	11
Aquatic	A5	9	F	N/A	3	3
Aquatic	A6	12	M	11	5	9
SO Only	S1	15	M	14	1	0
SO Only	S2	14	M	14	20	9
SO Only	S3	15	M	14	20	37
SO Only	S4	14	F	11	23	26
SO Only	S5	12	M	11	30	27
SO Only	S6	14	M	14	75	75
SO Only	S7	14	F	11	69	50
SO Only	S8	13	M	13	20	14

Table 7.

Extended Arm Hang Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of seconds)	Pre Test	Post Test
Aquatic	A1	10	F	15	1	4
Aquatic	A2	9	M	N/A	6	1
Aquatic	A3	9	F	N/A	6	12
Aquatic	A4	11	M	23	3	1
Aquatic	A5	9	F	N/A	1	0
Aquatic	A6	12	M	23	1	1
SO Only	S1	15	M	N/A	2	3
SO Only	S2	14	M	N/A	0	0
SO Only	S3	15	M	N/A	3	2
SO Only	S4	14	F	N/A	16	17
SO Only	S5	12	M	15	6	4
SO Only	S6	14	M	N/A	30	21
SO Only	S7	14	F	N/A	4	4
SO Only	S8	13	M	N/A	30	20

Table 8.

Flexed Arm Hang Specific Standards for Children with Intellectual Disabilities vs. Research Participants

Group	Participant	Age	Gender	Standard (# of seconds)	Pre Test	Post Test
Aquatic	A1	10	F	N/A	1	1
Aquatic	A2	9	M	N/A	1	1
Aquatic	A3	9	F	N/A	1	0
Aquatic	A4	11	M	N/A	1	1
Aquatic	A5	9	F	N/A	0	0
Aquatic	A6	12	M	N/A	1	2
SO Only	S1	15	M	8	0	0
SO Only	S2	14	M	8	0	0
SO Only	S3	15	M	8	0	0
SO Only	S4	14	F	4	15	10
SO Only	S5	12	M	N/A	0	0
SO Only	S6	14	M	8	16	16
SO Only	S7	14	F	4	0	0
SO Only	S8	13	M	6	20	30

Table 9.

Back-Saver Sit and Reach General Standards for Children vs. Research Participants

					Right Leg		Left Leg	
Group	Participant	Age	Gender	Standard (in.)	Pre Test	Post Test	Pre Test	Post Test
Aquatic	A1	10	F	9	13	14	13	13
Aquatic	A2	9	M	N/A	12	12	13	11
Aquatic	A3	9	F	N/A	13	15	13	14
Aquatic	A4	11	M	8	13	11	12	11
Aquatic	A5	9	F	N/A	15	7	15	7
Aquatic	A6	12	M	8	6	7	6	7
SO Only	S1	15	M	8	17	17	16	16
SO Only	S2	14	M	8	0	15	0	12
SO Only	S3	15	M	8	11	11	12	11
SO Only	S4	14	F	10	19	16	18	15
SO Only	S5	12	M	8	14	14	14	16
SO Only	S6	14	M	8	12	18	19	17
SO Only	S7	14	F	10	10	10	11	10
SO Only	S8	13	M	8	11	12	12	12

APPENDIX F

IRB Approval Letter

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
1L-09 Brody Medical Sciences Building• 600 Moye Boulevard • Greenville, NC 27834
Office **252-744-2914** • Fax **252-744-2284** • **www.ecu.edu/irb**

TO: Sara Elizabeth Miller, 2016 Copper Beach Way #105, Greenville, NC 27858

FROM: UMCIRB

DATE: September 8, 2011

RE: Expedited Category Research Study

TITLE: "The Effects of Participation in a Supplemental Aquatic Exercise Program on the Physical Fitness Levels of Special Olympic Athletes"

UMCIRB #11-0522

This research study has undergone review and approval using expedited review on 9.2.11. This research study is eligible for review under an expedited category number 4 & 7 which include collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications.) Examples: (a) physical sensors that are applied either to the surface of the body or at a distance and do not involve input of significant amounts of energy into the subject or an invasion of the subject's privacy; (b) weighing or testing sensory acuity; (c) magnetic resonance imaging; (d) electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, electroretinography, ultrasound, diagnostic infrared imaging, doppler blood flow, and echocardiography; (e) moderate exercise, muscular strength testing, body composition assessment, and flexibility testing where appropriate given the age, weight, and health of the individual and it is also a research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)
The Chairperson (or designee) deemed this **unfunded** study **no more than minimal risk** requiring a continuing review in **12 months**. Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.
The above referenced research study has been given approval for the period of **9.2.11** to **9.1.12**. The approval includes the following items:

- Internal Processing Form (received dated 8.26.11)
- Informed Consent: Exercise Group (dated 8.26.11)
- Informed Consent: Control Group (dated 8.26.11)
- Minor Assent: Exercise Group (received dated 8.26.11)
- Minor Assent: Control Group (received dated 8.26.11)
- Brockport Physical Fitness Test Form (received 8.26.11)
- Emails from research sites (received 9.8.11)
- Flyer

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

The UMCIRB applies 45 CFR 46, Subparts A-D, to all research reviewed by the UMCIRB regardless of the funding source. 21 CFR 50 and 21 CFR 56 are applied to all research studies under the Food and Drug Administration regulation. The UMCIRB follows applicable International Conference on Harmonisation Good Clinical Practice guidelines.

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