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### Keywords

Aquatic exercise; Disabilities; Hydrotherapy; Surfing rehabilitation

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## Development of a Wet Suit for Children With Down Syndrome

**Linda Suzan Lamont, Peter Panagiotis, Cortney Armitano, and Emily Clapham**

Individuals with Down syndrome have body types that make it difficult to fit for a standard wet suit. In general, their body composition includes an increase in central body adiposity and an endomorphic somatotypic body type in which the trunk is large while the limbs are shorter. Because of these physical characteristics, the participation by individuals with Down syndrome in aquatics exercise programs in which wet suits are needed can be very limiting. We observed that it was challenging to get these aquatic exercise participants into and out of the wet suits that had a standard wet suit design. This article describes a modified wet suit that is more accommodating for individuals with Down syndrome and allows them to wear the suit with less assistance. Although designed with the Down syndrome individual in mind, this modification may be useful for others with movement restrictions or who have an increase in central body fat.

*Keywords:* hydrotherapy, aquatic exercise, surfing rehabilitation, disabilities

The popularity of aquatic exercise for both fitness and rehabilitation is on the rise among the general public as well as individuals from special populations (Denning, Bressel, Dolny, Bressel & Seeley, 2012). One specialized population who can benefit from aquatic exercise is those with Down syndrome. We piloted an eight week surfing program for children with disabilities that included many individuals with Down syndrome (Clapham, Armitano, Lamont, & Audette, in press). This surf program is known as the University of Rhode Island's Ocean Therapy program. It is conducted and supervised by faculty and students in the Department of Kinesiology (both physical education and exercise science practitioners). The program had 16 children (mean age = 10.8 years) who participated in surf lessons twice a week for one hour during the spring and summer months of 2012. Pre- and posttesting of these children using a battery of tests from the Brockport Physical Fitness Manual (Winnick & Short, 1999) determined that there was a significant improvement in strength, flexibility, and cardiorespiratory endurance during the months of the program. These physiological adaptations were consistent with the literature on the benefits of surfing for the disabled participant that have previously been reported (Fleischmann, et al., 2011).

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Surf equipment was rented from a local surf shop and consisted of various-sized surf boards and wet suits. One of the difficulties that we encountered during this program was getting the children into and out of a wet suit that was not specifically designed for their body type. Children with Down syndrome are born with a genetic predisposition to become overweight and have anthropometric differences compared with their age-matched peers. Growth charts for children with Down syndrome indicate that this tendency to be overweight begins in late infancy and continues throughout their remaining growing years to 18 years of age (Cronk, Crocker, Pueschel, Shea, Zackai, Pickens, & Reed, 1988). Studies in adults with Down syndrome found that their somatotypes are highly endomorphic with the majority being classified as mesomorphic-endomorph (Grammatikopoulou, Manai, Tsigga, Tsiligrioglou-Fachantidou, Galli-Tsinopoulou, & Zakas, 2008).

The faculty of this surf program observed that the standard wet suits available for the general public may be the correct length, but are too small to accommodate the girth of torso, arms, and legs of children with Down syndrome. On the other hand wet suits that fit these children's trunk girth are too long, and the arm and leg widths are too narrow. These generally available standard-sized suits made it difficult for the children with Down syndrome to get into and out of the suit. Therefore, we decided to field-test a specially designed suit during the University of Rhode Island Ocean Therapy program in 2013. We report our observations in this paper.

## Method

The University of Rhode Island Ocean Therapy program met at a town beach in Narragansett, Rhode Island during May and June of 2012 and was popular enough to continue during the spring and summer of the following year (the spring of 2013). This exercise program was approved by the University of Rhode Island Institutional Review Board (IRB), and an informed consent was obtained from parents or guardians and an assent form was signed by each child.

## Participants

Participants enrolled in 2013 were 5 girls and 11 boys. The ages and clinical diagnoses of these children varied. Their ages ranged from 5–17 years with a mean age of 10.8 years. Because of our experience with generally available wet suits during the 2012 season, modified wet suits were constructed over the winter off-season. These modified suits were then observationally tested during another eight weeks of programming during the 2013 season. Although the Internet indicated that there are modified wet suits used for adapted scuba diving (“Wet suits and watersports accessories,” 2013), to our knowledge the following is a unique suit modification to be tested in an ocean surfing environment by children with Down syndrome. Figure 1 illustrates the modified suit as worn by a participant in our surfing program. Figure 2 illustrates our modified suit in comparison with a more typical wet suit design.

## Procedures

Steps in modifying the suit design involved measuring the height of the children with Down syndrome. Then, we reduced the measurement by two inches. Two



**Figure 1** — Specialized wet suit on a child.



**Figure 2** — Specialized wet suit compared with one of typical design.

inches was a visual estimate of the alteration needed to fit each child. Next, we increased the body length of the suit from neck to the crotch, the upper arm and lower arm, and the upper leg and lower leg by two inches. The wrist and ankle and neck circumferences as well as the leg lengths from crotch to feet also were *increased* by two inches. The wet suits were constructed using a very flexible, soft 3 mm neoprene material supplied by Hyperflex Wetsuits (Millville, NJ, USA). Lastly, and most importantly, long zippers were placed on both the back and the front as well as very long entry zippers on both of the arms and legs (see Figure 3). This modified wet suit design allowed the children to get themselves into and out of the wet suit with minimal or no adult assistance.



**Figure 3** — Wet suit opened at entry and exit zippers.

## Results and Discussion

This modified suit design has entry and exit zippers that allow the suit to be put on and taken off independently and quickly by children with Down syndrome. We designed it to fit the particular body types of our participants, while allowing normal range of motion and keeping them warm in the cold ocean water.

We estimate that the long entry zippers on the back and front of the wet suit torso and the zippers placed on the arms and legs also should prove useful for those

with other medical diagnoses that alter mobility and affect thermal stress during exercise, such as individuals with spinal cord injury or spina bifida. It has been documented that spinal cord-injured individuals who exercise in cold environments may experience an excessive heat loss (Janssen & Hopman, 2005). Therefore a wet suit that is easy to get into and out of and that fits well can be of utmost importance to surfers with these types of disabilities.

Because obesity is an issue for many with disabilities, aquatic exercise can be of value for providing a mode for rehabilitation, fitness, and weight loss. This modified wet suit design may be of value to an aquatic's program staff since the staff provides fitness services for overweight or obese individuals with various types of disabilities. In particular, the use of front and back entry and exit zippers in the torso, as well as along the arms and legs, may be of value to those with mobility issues such as arthritis sufferers. Lastly, we experienced no reported problems with skin allergies or irritation while using these suits; however, none of our children's parents or guardians reported skin allergy or irritation medical issues in their pre-participation medical history questionnaire.

Many of the children in the University of Rhode Island Ocean Therapy surf program reported that getting the specially designed wet suit allowed them greater independence. One parent wrote to us about purchasing the suit at the end of the program. She commented, "[The suit] is so amazing and empowering. We spend a lot of time in the water . . . and are heading to Maine in a few weeks. The idea of having that type of wet suit that she can easily use is *amazing*."

## Conclusion

Overall, we observed that the modified wet suit design was of value to the young participants in our 2013 surfing program. Our informal field testing indicated that they were both user-friendly and effective. Because there are other surf and diving programs for those with disabilities, we believe this wet suit modification may prove useful for their needs as it did for our program. In the United States, some of these disabled surf programs include Surfers Healing, Ride-a-Wave, AmpSurf, and Ocean Healing Group (<http://www.oceanhealinggroup.org/>); there also is the Disabled Surfer's Association in Australia and Freedom Surf in the United Kingdom (<http://www.freedomsurf.org/>). Finally, we feel that many aquatics program staff may find this modified wet suit design useful for their educational or adapted swim programs.

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