

4-25-2023

## Addressing Swim Safety in Autistic Children: A Pilot Feasibility Study Using Aquatic Occupational Therapy

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### Recommended Citation

Kemp, Erika; Woodson, Rebecca; and Baldino, Maria (2023) "Addressing Swim Safety in Autistic Children: A Pilot Feasibility Study Using Aquatic Occupational Therapy," *International Journal of Aquatic Research and Education*: Vol. 14: No. 1, Article 2.

DOI: <https://doi.org/10.25035/ijare.14.01.02>

Available at: <https://scholarworks.bgsu.edu/ijare/vol14/iss1/2>

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### Cover Page Footnote

The authors would like to acknowledge the following research team volunteers: Nicole Roberge, Dana Malesky, Bailey Benoit, Alyssa Marquette, Paige Crocker, Carolyn Manuck, Casey Miller & Angela Rittler. This research was funded by the Franklin County Board of Developmental Disabilities and the use of the pool at West Central School.

### **Abstract**

Drowning is a leading cause of accidental death for children under 14 with autism spectrum disorder (ASD). The purpose of this mixed methods study was to determine the feasibility of aquatic occupational therapy to increase swim skills for children with ASD following 10 weeks of intervention. Eight children, ages three to seven years old, participated in aquatic group-based occupational therapy to increase their swim skills. The Water Orientation Test Alyn-2 (WOTA2) and Goal Attainment Scaling were utilized to assess the change in participant swimmers' skills. Qualitative data were gathered through individual parent interviews. All participants increased in total score on the WOTA2 and 81% of all individualized goals were met or exceeded. Themes derived from parent interviews included benefits of participation, acquired skills, and value of the occupational therapy approach. The results of this study supported the value and feasibility of aquatic occupational therapy to increase swim skills in children with ASD.

*Keywords:* occupational aquatic therapy, autism spectrum disorder (ASD), swim skills, parental perspective

### **Introduction**

Wandering, also called elopement, is a concern for one in four children with autism spectrum disorder (ASD), Intellectual Disability or both (Rice et al., 2016). Of children with ASD who wander, drowning is the leading cause of accidental death, accounting for 71% of deaths between 2011 and 2016 (National Autism Association, 2017). Research conducted in typically developing pediatric populations assessing reducing drowning risks associated formal swim instruction with a decrease in the rates of drowning (Brenner et al., 2009). Additionally, it has been reported that swimming and water play are desired and appropriate activities for families with children with ASD (Little et al., 2014). It is important to discover what methods and techniques may increase swim skills in the ASD population, thus enabling families to safely engage in desired leisure activities.

Typical group swim lessons appear to be successful in teaching the general pediatric population to swim; however, parents have reported that their children with ASD often were not successful learning to swim in typical group swim lessons (Lawson et al., 2019). Children with ASD experienced difficulties with social interaction, communication, performance of gross motor skills, and sensory processing which subsequently affected their functioning and learning styles (American Psychiatric Association, 2013). Typical community-based swim lessons taught in a group format with one teacher for 4-8 children for 30-minute sessions usually did not take into consideration the unique learning needs of children with ASD.

There has been a recent increase in the amount of literature looking at how to increase swim skills among this population; however, recent literature has not provided an agreed upon approach for this specialized instruction. Approaches have included applied behavioral analysis (Martin & Dillenburger, 2019), aquatic exercise (Fragala-Pinkman, et al., 2011), aquatic occupational therapy (Alaniz, et al., 2017), and the Halliwick Concept (Aheren & Coghlan, 2017). Studies have been carried out by a variety of professionals including adapted aquatics instructors, occupational therapy practitioners, physical therapy practitioners, applied behavior analysts, and adapted physical education teachers.

Occupational therapy practitioners are trained in several therapeutic methods including developmental skill acquisition, motor learning, sensory processing, and behavioral theory. Occupational therapy practitioners often combine therapeutic approaches during interventions to support optimal participation results (American Occupational Therapy Association, 2020).

The Halliwick concept is one approach that also considers both motor and psychosocial aspects of learning to swim by first addressing comfort in the water (mental adjustment) and then focusing on gaining control of balance in the water (balance control) to ultimately achieve independent movement and locomotion in the water (Greswell, 2015). The Halliwick concept provides one-to-one support within a group setting, thus taking advantage of visual modelling as well as individualizing instruction (Greswell, 2015). Such an approach can provide an adaptive model for occupational therapy practitioners to use with children with ASD.

Given the high value placed by many families on swimming as a family activity, the numerous mental and physical performance skills required to learn to swim, and the variety of approaches seen in the literature, occupational therapy practitioners are well positioned to address increasing skills during this valued activity for their clients. The researchers of this study aimed to answer the following questions: 1) Is group-based aquatic occupational therapy a feasible intervention to increase swim skills in children with ASD? 2) What are parents' perceptions of the instructional methods and of the results for their family's following participation in the program?

### **Method**

This was a mixed method pilot study to examine the feasibility of a group-based aquatic occupational therapy intervention with a single group of participants. Mixed methods was chosen in order to gather both quantitative and qualitative data about the intervention to provide more in-depth descriptive information. Quantitative data regarding change in swim skills was collected using standardized

assessments. Qualitative data provided information regarding parent perceptions of the value of the approach. A feasibility study was chosen to look at adherence to the intervention protocol, whether or not participants would comply to the intervention by attending all the sessions, and participant tolerance and satisfaction with the intervention.

### **Participants**

The participants in the study were eight children aged three to seven years with diagnosed autism spectrum disorder (ASD) and their parents, guardians, or primary caregivers. Diagnosis of ASD was determined via parent report of the child's medical diagnosis by a medical professional. The participants were identified through a convenience sample in Central Ohio. IRB approval was received by the institution with which the lead author was affiliated, and informed consent was obtained from each parent and child dyad prior to commencing intervention.

### **Measures**

#### ***Water Orientation Test Alyn 2 (WOTA2)***

The main outcome measure utilized was the Water Orientation Test Alyn 2 (WOTA2) to assess the child's skills in the water (Tirosh et al., 2008). The WOTA2 is based on the Halliwick concept and has two main components: mental adjustment and balance control & movement in the water. This reliable and valid standardized assessment tool consists of 27 specific swim skills scored on a 0-3 scale with a minimal detectable change (MDC) in score of 11.5. The WOTA2 was reported to have good test-retest reliability (ICC=.97) and has been validated with populations of children with difficulties following simple verbal commands, similar to the challenges present in children on the autism spectrum. All researchers were trained on this instrument prior to the start of the study which included self-study with the items and ratings as well in water training and practice with the first author. Each child was assessed using the WOTA by their primary swim buddy which allowed the child to feel comfortable with the assessor. The primary investigator, a licensed occupational therapist, was present for all assessments and was available for discussion on items of question.

#### ***Goal Attainment Scaling***

Goal attainment scaling (GAS) is a criterion-referenced method which has been shown to be an effective measure of assessing clinical change among children with ASD, particularly when sensory processing deficits are present (Mailloux et al., 2007). Three to four individualized goals were created for each child based upon parent goals, initial WOTA2 scores, and clinical observations both on land and in the water by a licensed occupational therapist. These were reviewed and edited in consultation with a second licensed occupational therapist with special attention paid to the even spacing between levels of goal achievement.

### ***Initial Assessments***

An initial land-based assessment was completed with each child and guardian dyad to gather information on the child's underlying motor, cognitive, and social skills as well as to gather information on aquatic skills and prior aquatic exposure. Parents of each participant completed a questionnaire to determine the importance and comfort of safety and swim skills for their child prior to the intervention. A Sensory Profile-2 was completed as well as discussion of the parent's goals for the aquatic intervention. This initial assessment helped to form the clinical picture that guided the creation of individualized goals and intervention.

### ***Parent/Guardian Interviews***

Seven of the eight parents/guardians completed an individual interview regarding their perspective of the intervention with a research team member not directly involved in the water sessions. One parent required the interview to be completed via email due to a communication barrier.

### ***Procedures***

Group-based aquatic occupational therapy intervention was provided once a week for over 10 weeks in a warm water pool (temperature = 90 degrees) located within a local school for children with developmental disabilities. All participants were paired 1:1 with a swim buddy, a current occupational or physical therapy student who had completed their pediatric coursework with knowledge of therapeutic principles and ASD. The swim buddies individualized the intervention to the needs of each child under guidance of two licensed occupational therapists.

Each intervention session lasted 45-60 minutes and had an established routine and structure with embedded individualized activities. Each child had an individualized visual schedule and was paired with a consistent swim buddy to allow therapeutic relationship development. The group began with a song for water acclimation and to signify the start of the session, followed by two to three minutes of water adjustment. The group gathered for instruction in the swim skill of the week, guided by the Halliwick concept, followed by transition to individual skill stations which utilized playful activities and games to encourage participation and skill development. Thirty minutes of the intervention session was spent rotating between these stations to review the weekly skill and target individualized goals during which swim buddies utilized therapeutic techniques such as grading and adapting activities to the child's level, therapeutic handling, and behavior management techniques. The remaining time was utilized for group songs to signify the end of the lesson and allow time for parent education and discussion of progress towards goals.

The introduction of swim skills aligned with the progressive fashion of the Halliwick concept which were also incorporated into station work during the remaining time in the session. Initially, water acclimation was the focus of the swim skills followed by blowing bubbles (breath control), floating on the front and back, kicking, and locomotion skills. Each child also spent time during each session at a station specifically focused on individualized goals related to the GAS for that child.

Adherence to the protocol on a weekly basis was maintained with minor modifications for one participant for whom stations were brought to him versus he was travelling throughout the pool. Debriefing was completed between swim buddies and licensed therapists immediately after each session for adjustments to individual child's needs. All participants tolerated the intervention well with all eight attending and finishing at least 8 of the 10 sessions.

### **Data Analysis**

Data from the WOTA2 were calculated using descriptive statistics compiled in a Microsoft Excel spreadsheet. Goal Attainment Scaling was analyzed using conversion to T scores (Kiresuk et al, 1994). Parent interview data were de-identified, transcribed by one researcher and individually coded, and recorded as Microsoft Word files. Through discussion between two research team members, themes were compared, collapsed, and data re-coded. After a latent period, themes were again discussed between two team members and further collapsed (Cresswell & Poth, 2018).

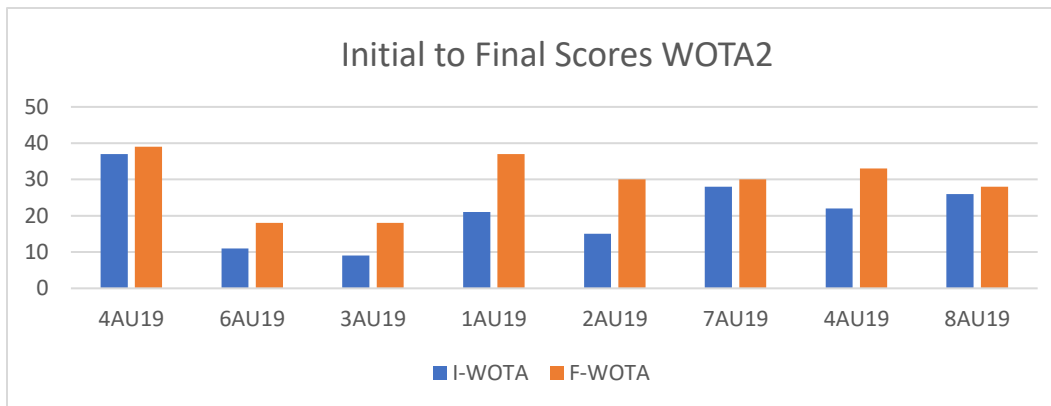
### **Results**

All eight participants increased their total scores on the WOTA2 from initial to final assessment. Four participants met the MDC of 11.5, mimicking a prior study (Tirosh et al, 2008). See Figure 1 for graphic illustration of the details.

Participants had either three or four individualized goals, depending on their needs. Goals were focused on non-performance of skills that limited full participation in the occupation of swimming or swim safety skills not addressed via the WOTA2. Of the total number of goals set, 81% of those goals were met or exceeded. Scores from the GAS were converted to T scores, with an average of 50 and standard deviation of 10. The group mean was 61.4, indicating that goals were met or exceeded as a group by 1.4 standard deviations. Individual T scores ranged from 45.4 to 77.4. An example goal using GAS is depicted in Table 1.

**Figure 1**

*Initial and final scores on the WOTA2 for each participant*



**Table 1**

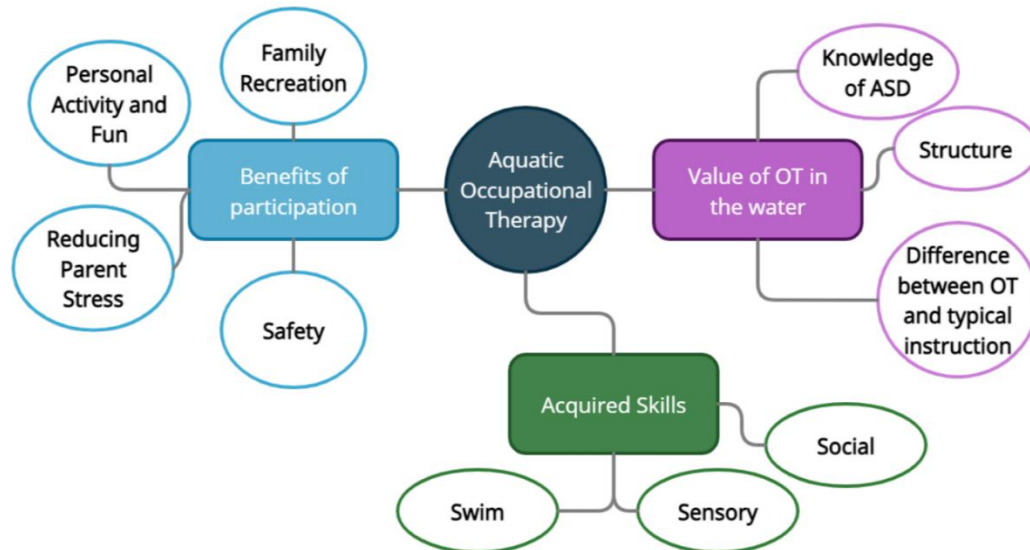
*Example of Goal Creation and Structure Through Goal Attainment Scaling*

Goal	-2	-1	0	+1	+2
Blowing bubbles through nose while maintaining a bilateral kick using kickboard with extended arms for 20 kicks, taking 1-2 breaths.	No kicking and face not in the water.	Able to kick with straight legs demonstrating a bilateral reciprocal pattern, and able to blow bubbles but cannot do both at the same time.	Blowing bubbles through nose while maintaining a bilateral kick using kickboard with extended arms for 20 kicks, taking 1-2 breaths.	Rhythmic breathing while bilateral kicking at least 20 kicks.	Rhythmic breathing greater than 20 kicks.



**Figure 2**

Concept map of themes discovered from parent/guardian interviews



The parent/guardian perspective was gathered via qualitative interview yielding three main themes of 1) *value of OT in the water*, 2) *benefits of participation* and 3) *acquired skills*. Each theme has several subthemes as illustrated in Figure 2. *Benefits of participation* included subthemes of safety, reducing parent stress, personal activity and fun and family recreation. This theme was coded when the parent discussed the benefits they saw from their child participating in the group. Several benefits seen from the data included a desire for their child to gain safety skills around the water.

“Mostly he’s very interested in the water like a lot of autistic kids are... God forbid he ever gets away from me around the water. I want him to know what to do. Safety first.” (Parent 6).

Additional subthemes included reducing parent stress concerning aquatic activity, enabling the child to have a fun activity that is their own as well as increased the child’s capability to participate in a family leisure occupation.

“So, I think just watching that...has been nice to our entire family and watching [child’s name] continue to do better in the water is always a good thing for you know our family in general because we have a younger son and a younger daughter and they like the water too so all of us wanting to be in the water is good.” (Parent 7)

“...I want her to do stuff; she doesn’t seem to like team sports that much so this is like something she can do that she really enjoys that gives her goals that she can work on, on her own.” (Parent 5)

The second theme was *value of OT in the water* which included subthemes of knowledge of ASD, structure of the sessions, difference between OT and typical swim instruction.

"I think the focus on specific motor skills, I also think that the fact that they are specially trained to deal with autistic children is a plus" (Parent 3)

“It’s huge because from an OT perspective you understand the challenges that these kids have where just everyday people may not so there is a lot more patience, a lot more understanding which is obviously needed.” (Parent 2)

The last theme was that of *acquired skills*, which was coded whenever the parent discussed any skills the child had gained from participation in the group. Subthemes of social skills, swim skills and sensory skills were noted.

“I would say definitely swim skills from the perspective of being on his stomach, being on his back, going under water a little bit more. So, the more refined focus on some specific skills have been helpful for him” (Parent 3)

“I mean she has made so much more progress since she has been doing this than she did in any of the swim lessons she did before this” (Parent 5)

### **Discussion**

Given that all eight children tolerated the intervention with good adherence to the protocol with all attending at least eight of ten sessions demonstrated that aquatic occupational therapy is feasible to carry out with this population. Skill gains seen quantitatively on WOTA2 and the GAS also suggested that aquatic occupational therapy had an effect on increasing swim skills in autistic children. These skill gains were corroborated from parental perspective as revealed through qualitative interviews.

The initial land-based assessments indicated that participants had deficits in multiple areas, including sensory processing, motor behavior, and praxis, indicating that an occupational therapy perspective during aquatic intervention may increase performance skills needed to participate in the recreational activity of swimming. Using an occupation-based activity analysis approach, it was possible for the authors to use knowledge gained from initial assessments to design sessions that

targeted each participant's specific need. This process aligned with the gathering of an occupational profile in a typical land-based occupational therapy assessment and ultimately encouraged the use of an occupation-based structure for this aquatic program, differentiating the approach from typical swim lessons. Throughout the program, swim skill goals were achieved through play-based activities that were typical of an occupational therapy treatment session. This playful approach also allowed the child to recognize swimming as a fun activity, thus reducing fearful behaviors as evidenced through increased water adjustment as measured on the WOTA2, and decreased parental stress as reported in the interviews. Occupational therapy practitioners should be considered as a resource to provide this type of intervention to increase swim skills in children with ASD.

Often aquatic occupational therapy services are not covered by insurance, but rather are private pay which many families may not be able to afford. The findings of this study suggested that using physical and occupational therapy students as assistants may be a viable method of delivering aquatic therapy services which could help defray economic concerns for this type of intervention. This model offered a feasible way for one licensed therapist to oversee eight participants and students.

The aim of this type of aquatic intervention was not to teach children to swim with perfection but instead, provided them the basic safety and swim skills needed to transition to a more typical swim lesson structure in their own communities, or even to an age-group swim team. The goals of this therapeutic intervention included children gaining an understanding of the basic instructional methods used by typical swim instructors, overcoming fear of the water, and having increased safety skills both on deck and in the water. Some of the safety skills taught and reinforced included not entering the water before their buddy gave them the safe word, how to turn around in the water to get back to the side, how to enter/exit, and how to perform a safety back float to rest and breathe if fatigued while swimming. By the end of this program, most participants understood the structure of the lessons, gained basic swim skills, and both parent and child demonstrated increased comfort with aquatic interventions which might allow families to move to a community-based swimming program.

### **Limitations**

This cohort study was not easily generalizable due to the small, convenience sample from one location. We noted that WOTA2 was not a sensitive enough measure for the children with no prior water experience; therefore, we recommend that the WOTA1 should be used to gather specific data for those cases with few prior swim experiences. We are unable to report measures of rater agreement for the WOTA since we had each child assessed by their swim buddy in order to ensure comfort

being handled in the water. Additionally, the goals created for GAS would have benefited from closer consideration to not target the skills already being assessed by the WOTA.

### **Recommendations for Further Research**

While additional research on adaptive aquatic approaches for children with ASD has begun to be published, the active ingredients of the OT approach and/or curriculum needs to be further clarified. We also recommend that research be conducted to identify the minimum swim safety skills needed and the length of time required to achieve those skills for basic safety in and around the water.

### **Conclusion**

This study demonstrated that aquatic occupational therapy is a feasible method to increase swim skills for children with ASD. The parents also reported valuing this approach for their participants. The need for aquatic interventions for this population is evident and occupational therapy practitioners should be considered as possible professionals to provide these services to help fill this need.

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