

## Research Article

# The Impact of Participation in an Aquatic Exercise Program on Behavior in Children with Autism Spectrum Disorder: A Preliminary Study

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## Abstract

**Introduction:** Children with Autism Spectrum Disorder (ASD) often demonstrate problem behaviors. The purpose of this study was two-fold:

- 1) To determine if participation in an aquatic exercise program improves behavior in children with ASD, and
- 2) Determine if aquatic exercise is a socially valid intervention to improve behavior.

**Methods:** Thirteen children, ages 3-15 years old, with a diagnosis of ASD engaged in an aquatic exercise program 1X/week for 6 weeks. Outcome measures included The Pervasive Developmental Disorder Behavior Inventory (PDDBI) and the Intervention Rating Profile (IRP-15).

**Results:** Statistically significant improvements on the arousal regulation problems sub domain ( $p=0.034$ ) of the PDDBI were found. All parents agreed that the intervention had a positive effect on behavior (91% strongly agree/agree, 9% slightly agree).

**Conclusion:** Results suggested that aquatic exercise may lead to improved behavior and is a socially valid intervention. Aquatic exercise should be considered as a safe and effective behavioral intervention in children with ASD.

**Keywords:** Autism spectrum disorder; Aquatics; Exercise; Behavior; Social validity; Arousal

## Abbreviations

ASD: Autism Spectrum Disorder; PDD: Pervasive Developmental Disorders; IRP: Intervention Rating Profile

## Introduction

Children with Autism Spectrum Disorder (ASD) often demonstrate behavioral problems that negatively impact participation at home and in the community. When compared to peers who are typically developing and those with intellectual disabilities, children with ASD have been shown to demonstrate significantly more aggression, inattention, and withdrawal behaviors [1]. Children with ASD also demonstrate self-injurious and stereotypical behaviors. A higher frequency of stereotypic behaviors has been correlated with increased irritation, lethargy, and hyperactivity in children with ASD, as well as increased parent stress [2]. The maladaptive behaviors commonly demonstrated by children with ASD have been found to have a significant negative impact on their families. Families of children with ASD have been shown to be at higher risk for financial and time burdens, as well as at increased risk for chronic physical, developmental, behavioral, or emotional conditions [3]. In a study by Phetrasuwun and Miles [4], mothers of children with ASD reported that managing demanding behaviors, mood changes and upset feelings, as well as managing behaviors in public places, was a significant source of parental stress. The mothers with higher parental

stress also reported more depressive symptoms [4]. Evidence suggests that exercise has a positive impact on behavioral problems associated with ASD. Two systematic reviews [5,6] examined studies comparing the effects of high intensity exercise (jogging) and low intensity exercise (ball throwing and/or walking) on stereotypic behaviors in children with ASD. These studies indicated high intensity exercise produced a decrease in stereotypic behaviors immediately following the intervention [7-9]. Several other studies also reported a decrease in stereotypic behaviors following jogging [10-13]. While the duration or impact of exercise on stereotypical behaviors has not been studied extensively, the effects appear to be of short duration [8,9,14]. Parents of children with ASD have also reported improvements in behavioral problems following an exercise program. In a recent study by Magnusson, Cobham and McLeod [15], a decreased frequency of behavioral problems were reported by all parents and guardians following their children's participation in a high-intensity, individualized, exercise program. These behavioral problems included self-stimulatory behaviors, self-harm, physical aggression and verbal aggression. An improvement was also evident in positive behaviors such as academic performance, attention to task, social skills, positive behavior towards exercise, voluntary participation in physical activity and positive participation in physical activity [15]. Participation in aquatic exercise programs specifically may lead to improved arousal levels in children with ASD. Impaired arousal in children with ASD has been documented in multiple studies with differing hypotheses as

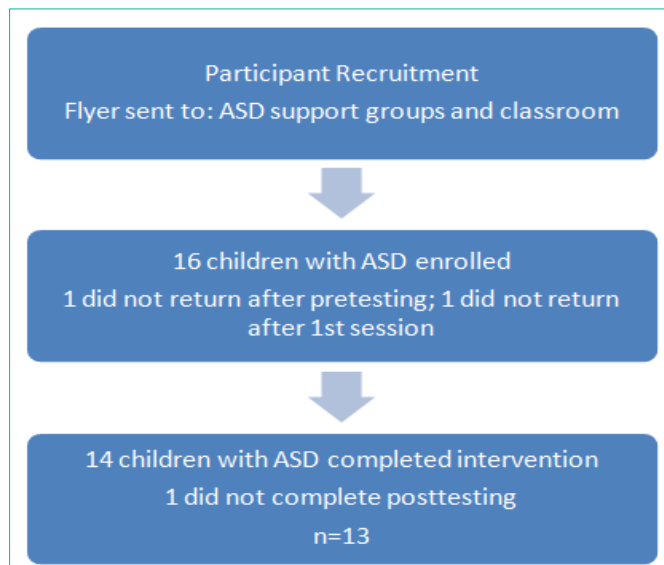


Figure 1: Process of Recruitment.

to the underlying pathology [16,17]. Constant somatic sensory input is provided to the child through the many properties of water, which may assist in modulating arousal. Improved arousal may then allow for children with ASD to more efficiently interact and learn in the aquatic environment [18]. According to Vonder Hulls et al. [18] therapists who have worked with children with ASD in aquatic environments reported a substantial increase paying attention, tolerating touch, and maintaining eye contact, among others. Therapists also reported that participants demonstrated fewer self-stimulatory behaviors. Fragala-Pinkham, Haley, & O’Neil [19] evaluated the effect of an aquatic exercise program held two times per week for 40 minutes over 14 weeks for children with ASD. This study did not formally measure the behavior of the participants however, on a parent satisfaction questionnaire the majority indicated their children had fewer problem behaviors and demonstrated better attention and focus while doing their homework as a result of the aquatic program. Parents also noted improvements in social skills such as increased eye contact, engaging in appropriate conversation with peers and instructors, and following class rules and class routines. A positive influence on social development and self-esteem were also noted [19]. Children with ASD often demonstrate behavioral problems that negatively impact their participation at home and in the community. Previous studies using aquatic interventions have shown a positive effect on behaviors and on social interaction; however, the evidence’s limited. The purpose of this study was two-fold:

- 1) To determine if participation in an aquatic exercise program improves behavior in children with ASD, and
- 2) To determine if aquatic exercise is a socially valid intervention for improving behavior in children with ASD.

It was hypothesized that problem behaviors in the arousal and sensory domains would improve with participation in aquatic exercise and parents would report this intervention as acceptable to manage their children’s behaviors.

## Method

**Participants:** The target population for this study were children

Table 1: Participant demographics.

Participant	Age (years)	Gender	Autism Quotient	Medications
1	5.83	M	46.00	None
2	12.67	M	49.00	Prozac, Intuniv
3	5.33	M	56.00	None
4	5.67	M	55.00	Cetirizine, Melatonin
5	13.08	M	60.00	Fluoxetine, Clonidine
6	3.92	M	*	None
7	12.42	M	34.00	None
8	8.67	M	38.00	Xopenex
9	5.50	F	41.00	None
10	9.67	M	62.00	Risperidone, Adderall XR, Clonidine
11	7.50	M	44.00	None
12	7.17	M	28.00	None
13	7.83	M	*	Tenex, Celexa, Risperdal

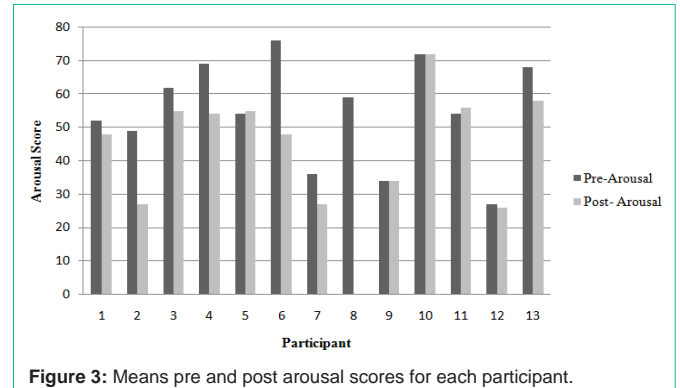
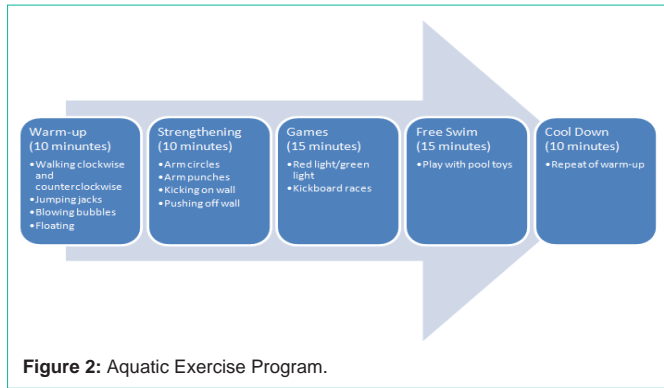
\*Score unable to be computed due to missing data

with ASD aged 3 to 15 years old. A flyer advertising the aquatic exercise program was distributed to local ASD support groups and to teachers in ASD support classrooms in local school districts to recruit participants. Inclusion criteria consisted of a definitive diagnosis of ASD, which was obtained through parent report. Children were excluded if they had not been diagnosed with this disorder, if the child was outside the target age range, or if the children were fearful of swimming in the pool. Sixteen participants were initially enrolled in the study. One participant did not return after the first aquatic exercise session, one participant did not return after completing pre-testing, and one additional participant did not complete post testing. These three participants were excluded from all data analyses, leaving thirteen participants (12 males, 1 female) that completed the study. Figure 1 describes the process of recruitment. The participants ages ranged from 3.9 years to 13.1 years (mean age = 8.1). Refer to Table 1 for participant demographics. While the gross and fine motor skills of participants were not formally assessed, participants were able to engage in all interventions without accommodations.

## Outcome Measures

**PDD Behavior Inventory:** The PDD Behavior Inventory (PDDBI) is a rating scale designed to assess responsiveness to intervention in children diagnosed with one of the Pervasive Developmental Disorders (PDD) [20]. Historically, these Pervasive Development Disorders have included Autism Spectrum Disorder, Asperger disorder, PDD not otherwise specified, and childhood disintegrative disorder [21]. The PDDBI was developed based on DSM-IV criteria. The PDDBI is a useful clinical tool for assisting in diagnosis and treatment recommendations and for assessing change over time in follow-up assessments [22]. The PDDBI subscales are scored as T-scores (mean of 50 and SD of 10), some of which are related to the chronological age of the child. The PDDBI yields an overall Autism Score, computed from DSM-IV relevant subscale T-scores [20]. The purpose of this score was to obtain a global estimate of an individual’s overall severity of autism, taking all relevant subscales into account [21].

**Intervention Rating Profile-15 (IRP-15):** The IRP - 15 was used



to assess the social validity of aquatic exercise as an intervention to improve behavior in children with ASD. The IRP - 15 was originally designed as a 20 item scale to assess teacher’s perceptions of acceptability of classroom interventions and has a good psychometric foundation. The original scale had good reliability ( $r = 0.91$ ) and the reported reliability of the IRP -15 was 0.98 [23,24]. Parents in this study rated their opinions of the effectiveness of the aquatic exercise program on a 15 question 6-point scale ranging from 1 (strongly disagree) to 6 (strongly agree), with total scores ranging from 15 to 90 and higher scores indicating greater acceptability [25]. According to Von Brock and Elliot [26], a total score on the IRP --15 greater than 52.5 indicates that the intervention is acceptable. Parents were also encouraged to provide any additional comments regarding the impact of their child’s participation in the aquatic fitness program.

**Data Collection**

This study was approved by the Institutional Review Board at Lebanon Valley College. One week prior to beginning the exercise program, an information night was held for the participant’s parents to complete all necessary paperwork, including the PDDBI, consent to participate, and photo release forms. The program was explained to each parent during the information session, and all questions regarding the program were answered. In the final session, parents completed the PDDBI again, as well as the Intervention Rating Profile (IRP-15) social validity scale.

**Intervention**

The aquatic exercise program was conducted for one hour, one day per week for six weeks in the Lebanon Valley College wellness pool. Professors from the Lebanon Valley College physical therapy and education departments led the exercise sessions from the edge of the pool, while physical therapy and education students engaged in hands on interaction with the participants while in the pool. One or two students were paired with each participant to ensure safety, participation in the exercises, and to encourage active participation throughout the entire one hour session.

The exercise program consisted of a 10 minute warm-up, 10 minute strengthening program, 15 minutes of games, 15 minute free swim, and 10 minute cool-down, which were all completed in the pool. The warm-up consisted of walking clockwise, walking counterclockwise, jumping jacks, and blowing bubbles/floating. Strengthening consisted of arm circles, arm punches, kicking while holding onto the wall and pushing off of the wall. Games included

red light/green light, and kickboard races while the free swim allowed participants to play with various pool toys, pool noodles, and kickboards. Participants repeated the warm-up activities as a cool-down to conclude each session. Figure 2 provides an overview of the aquatics program.

**Data Analysis**

Demographic data and the IRP-15 were analyzed using descriptive statistics including percentages, means and standard deviations. Pre and post-test results of the PDDBI were analyzed using paired t-tests. SPSS 22.0 was used for all data analyses.

**Results**

A paired samples t-test was conducted to compare behaviors reported on the PDDBI before and after completion of the aquatic exercise program. There was a statistically significant difference in the scores for pre arousal ( $M = 54.42, SD = 15.88$ ) and post arousal ( $M = 46.67, SD = 14.81$ );  $t(11) = 2.78, p = 0.018$ . Figure 3 shows the mean pre and post arousal scores for each participant. There were no other statistically significant differences for pre and post behaviors examined using the PDDBI. All pre/posttest scores of the PDDBI subdomains can be found in Table 2.

One parent of each of the thirteen participants reported on the social validity of aquatic exercise as an intervention for their children ( $n = 13$ ) using a modified version of the IRP - 15. In this study, the ratings for all 15 questions on the IRP - 15 ranged from 62 - 90 ( $M = 80.38, SD = 8.36$ ). These scores were all above 52.5, indicating that

**Table 2: Pre/Post Subdomain Scores of the PDDBI.**

	Pre test Score	Post test Score	p value
Sensory/Perceptual Approach Behaviors	51.7	52.7	0.597
Ritualisms/Resistance to Change	56	54.1	0.350
Social Pragmatic Problems	50	45.8	0.317
Semantic/Pragmatic Problems	52	51.3	0.744
Arousal Regulation Problems	55.8	47.6	0.034*
Specific Fears	55.4	52.6	0.328
Aggressiveness	56.5	53.2	0.555
Social Approach Behaviors	56.9	58.6	0.236
Expressive Language	54	54.5	0.726
Learning, Memory, and Receptive language	50.8	52.2	0.315

\*Statistically Significant

**Table 3:** IRP-15 Responses.

	Question	SA	A	SI A	SI D	D
1	This would be an acceptable intervention for a child's problem behavior.	61.5	30.8	7.7		
2	Most parents would find this intervention appropriate for behavior problems.	53.8	23.1	15.4	7.7	
3	This intervention was effective	38.5	46.2	15.4		
4	I would suggest this intervention to other parents.	76.9	15.4	7.7		
5	My child's behavior is severe enough to warrant use of this intervention.	23.1	53.8	15.4		7.7
6	Most parents would find this intervention suitable for behavior problems.	46.2	30.8	23.1		
7	I would be willing to use this intervention in the future.	76.9	23.1			
8	This intervention would not result in negative side effects for the child.	69.2	7.7	23.1		
9	This intervention would be appropriate for a variety of children.	53.8	38.5	7.7		
10	This intervention was consistent with others I have used to manage my child's behavior.	30.8	38.5	23.1	7.7	
11	This intervention was a fair way to handle my child's problem behavior.	46.2	38.5	15.4		
12	This intervention is reasonable for the problem behaviors my child demonstrates.	38.5	46.2	15.4		
13	I liked the procedure used in this intervention.	69.2	23.1	7.7		
14	This intervention was a good way to handle my child's behavior.	38.5	38.5	23.1		
15	Overall, this intervention had a positive effect on my child's behavior.	76.9	15.4	7.7		

N=13, Scores reported by percentage

SA: Strongly agree; A: Agree; SI A: Slightly agree; SI D: Slightly disagree; D: Disagree

aquatic exercise is an acceptable intervention for children with ASD. Table 3 presents IRP - 15 ratings from all 15 questions. All of the parents agreed the aquatic exercise intervention had a positive effect on their child's behavior (92.3% strongly agree/agree, 7.7% slightly agree). The parents also all indicated that they would be willing to use the intervention again in the future (100% strongly agree). Parents were also asked to provide any additional comments regarding their child's participation in the aquatic exercise program in an open-ended question on the IRP-15. Parents described improved behavior, as evidenced by the following quotes:

- “Overall, I feel that it helped to calm her for the evening.”
- “After a long day at school, he likes to relax and swimming and doing exercise here with the group was a good way for him to wind down and relax.”
- “On the days he had swimming he didn't need medication to sleep.”
- “I think that XXX has been showing nice improvement toward his language, cognitive and behavioral goals within the last six weeks.”

## Discussion

The results of this study suggest that participation in aquatic exercise has a positive impact on arousal regulation problems in children with ASD. Specifically, the results suggest that when children with ASD participate in aquatic exercise, their levels of kinesthetic behaviors, reduced responsiveness, and sleep regulation problems are reported as less frequent. Exercise performed in an aquatic environment allows for a reduction in the effect of gravity and may decrease contributors to secondary impairments in children with ASD. It is also thought to provide additional sensory stimuli, which also impacts children with ASD [27]. These variables may provide rationale for the reduction of arousal regulation behaviors of children with ASD. In conjunction with parent report from the IRP-15 data

indicating aquatic exercise as a socially valid intervention for children with ASD, the findings from this study suggest aquatic exercise as a valuable form of intervention. These findings support the hypothesis that participation in aquatic exercise would improve behaviors in children with ASD. The results also support previous findings by Vonder Hulls et al. [18] that indicated aquatic exercise programs may have positive effects on arousal level. Research suggests that early identification of abnormalities in arousal regulation in children with ASD will assist in directing these individuals towards appropriate intervention [17]. In addition, Pan [27] also found aquatic exercise to have positive impacts on children with ASD. The results of this study showed a reduction in antisocial behaviors and an increase in aquatic skills after a 10 week water exercise program. In a systematic review of the literature on the impact of aquatic exercise based on the Halliwick method, four studies were highlighted to have found positive improvements on social interactions or behaviors in children with ASD [28]. While the data collected within this study suggest that participation in aquatic exercise may positively impact arousal regulation problems in children with ASD, it is important to note aquatic exercise as an intervention has shown positive effects on a variety of populations of children with disabilities. In a study conducted by Chang et al. [29] suggested that an aquatic exercise program composed of both aerobic and coordinative exercises had positive impacts on restraint inhibition in children with ADHD. In addition, positive results were found in gross motor function and walking endurance in children with cerebral palsy after participation in aquatic exercise [30]. While this study focused on school age children, research also suggests a positive impact can be made with the toddler and early intervention population. For example, a study conducted by McManus and Kotelchuck significant gains in functional mobility was found when using aquatic therapy with infants and toddlers receiving early intervention programming [31]. The results also expanded evidence on the social validity of utilizing aquatic exercise as an intervention to improve behaviors in children

with ASD. The results demonstrated that most parents either agreed or strongly agreed that aquatic exercise is an effective intervention for managing their children's problem behavior. This is also evident as the IRP-15 rating scores exceeded the acceptability value for all thirteen parents. Additionally, parent comments on the IRP-15 supported the quantitative data. Attendance rates averaged 96%, with 11 participants attending 100% of sessions. This attendance rate also supports that parents found the intervention acceptable. This is consistent with findings from Fragala-Pinkham et al. [19] where parents indicated that their children had fewer problem behaviors following participation in an aquatics program. Since previous literature by Phetrasuwan and Miles [4] indicated that managing demanding behaviors, mood changes and upset feelings, and behaviors in public places is a significant source of parental stress, it is possible that participation in aquatic exercise may help alleviate some sources of parental stress since the results of this study suggested that aquatic exercise improves behavior. More research would be beneficial to aid in the identification of children with ASD that would benefit the most from an aquatic exercise program and to investigate the relationship between participation in aquatic exercise and parental stress. Limitations associated with this study included small sample size (n=13), large age range of participants, lack of a measure of intensity for the aquatic exercise, and incomplete PDDBI survey data. It is important to note the participants in this study were predominantly male; however, this anticipated in children with ASD. Previous research by Vonder Hulls et al. [18] indicated that participation in aquatic exercise has beneficial effects on sensory behaviors. Also, the arousal regulation domain of the PDDBI is strongly and positively correlated with the Sensory/Perceptual Approach behaviors domain of the PDDBI. Therefore, we expected to see a statistically significant difference in pre and post means for the Sensory/Perceptual Approach section. This inconsistency could possibly be explained by the limitation of the small sample size. Future studies should include larger sample sizes in addition to possible incentives for attending every session and returning posttest information. Overall, the findings of this study support the continued use of aquatic exercise as an intervention to manage arousal regulation problems in children with ASD. Despite the lack of statistically significant data regarding improvement in additional specific behaviors, an overwhelming percentage of parents found aquatic exercise to be beneficial for their children with ASD. If physical activity interventions such as an aquatic exercise program can effectively improve behaviors associated with ASD, then there may be a benefit to including them more often into the child's routine. The improved behaviors may lead to increased ability to participate in daily activities and a decrease in the need for parents to implement daily behavioral interventions. In conclusion, the results of this study suggest that aquatic exercise may lead to improved behavior, specifically arousal regulation, in children with ASD. Results also suggest that aquatic exercise is a socially valid intervention for improving behavior in children with ASD. Future research with larger sample sizes should be conducted to expand evidence on specific behaviors that might be impacted by aquatic exercise and to identify children with ASD that would benefit the most.

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