Research Report: Efficacy and Safety of a Novel Aquatic Device for Children With Postural Dysfunction

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Background and Purpose: Children with postural dysfunction often enjoy aquatic activities but are limited in their ability to play and interact in the water due to limited motor control and safety concerns. The purpose of this study was to explore the benefits of postural contexts provided by a novel aquatic device (Water Strider) in children with postural dysfunction. Providing stable vertical support is hypothesized to improve overall environmental interactions/social engagement and increase safety, autonomy, and motivation for movement (kicking and reaching).

Methods: The proposed device provided external support that could be modified on the basis of user-specific level of head and trunk control. Feasibility, safety, and efficacy of the device were tested for 9 children (aged 2-8 years) with postural dysfunction (7 with cerebral palsy). For this purpose, a 10-minute aquatic trial for baseline aquatic activities along with use of the Water Strider was performed for comparison with video behavior coding to quantify arm and leg movements, assistance, and hazardous events (water in eyes or water in mouth).

Results: Total assistance required significantly decreased from baseline (100%) to the Water Strider (21%; $F_{1,8}$= 384.4, $P \leq .001$), and significantly fewer instances where children were found to have water in their mouth occurred across all participants (baseline: 12 events; Water Strider: 0 events). Significant increase in total leg movement/reciprocal kicking ($F_{1,8} = 8.84$, $P < .001$; $F_{1,8} = 11.1$, $P = .003$) and decrease in arm movements ($F_{1,8} = 0.036$, $P < .001$) with relation to the level of trunk control were also observed. (J Aquat Phys Ther 2021;29(3):65–72)

Key words: aquatic therapy, assistive device, cerebral palsy, postural dysfunction

Populations with postural dysfunction often exhibit degraded trunk control and/or lack of ability to sit, stand, or walk unassisted. More than 30% of children with cerebral palsy (CP) never achieve stable sitting, and another 18% who can sit are unable to ambulate independently.[1] Deficits in postural control occur in children with a variety of other neuromotor and developmental diagnoses (eg, spinal cord injury, myelomenincocele, Down syndrome, and muscular dystrophy).[2-4]

Aquatic therapy is commonly used and preferred by children with postural dysfunction.[5] The availability of land-based activities for children with CP is also limited.[5] Preference for aquatic-based therapy exists potentially due to the unweighting properties and soothing effect of water; however, without upright posture to give children autonomy of their movements and time for interactions in the pool setting, there is a glass ceiling on the potential multisystem benefit.[6]

Benefits of aquatic therapy include improved muscle strength, greater levels of confidence and motivation, reduced tone (with warm water), improved cardiorespiratory fitness, improved body functions, and gross motor function/functional mobility.[2,6-8] Despite successful interventions for children with CP, there is a disparity of literature focused on aquatic-based intervention for children with moderate-to-severe CP (Gross Motor Functional Classification System [GMFCS] levels IV and V). This population is commonly excluded from participation or poorly represented in aquatic-based intervention studies, which is likely due to the lack of adequate aquatic activities available or associated difficulties with safe positioning of these children.[8-11] Many articles that included children of GMFCS levels IV and V do not list specific interventions in a way that allows them to be replicated, potentially due to the clinical judgment necessary to adequately accommodate the complexity and variability found in this population.[7,11,12]

Neck floatation devices are commonly used during various forms of aquatic therapy and aquatic recreational activities. One study included in a systematic review by Roostaei et al[10] reported an 88% attendance rate for an included

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intervention article, with upper respiratory tract infection being the primary reason for absence. Without detailed reporting of individual aquatic interventions and limited availability of aquatic devices, it is plausible that the neck floatation devices were used by studies included in this systematic review.[10] Despite the study's final report of aquatic therapy being safe with minimal adverse side effects, water aspiration during aquatic activities could have caused the reported upper respiratory tract infections.[10]

Populations with postural dysfunction require more complex positioning devices on land including wheelchairs, walkers, standers, and special seating and bathing devices.[13] Commercially available devices for aquatics are helpful for supporting individuals who do not yet know how to swim but are usually not safe when used for individuals with postural dysfunction. Thus, these children require hands-on support by the parent, caregiver, or clinician in addition to aquatic devices.

These researchers have developed an adjustable trunk support system with outriggers for floatation and stability. Adaptations for head and upper extremity support were created for children with the most severe postural deficits. The support was developed with the intent of allowing children to keep their heads above water, look around the environment, explore the effectiveness of kicking and moving their arms, and interact autonomously with caregivers and other people in the pool.

These researchers present a description of the trunk support system and demonstrate initial feasibility and efficacy of the device for a group of children with postural dysfunction. Feasibility was based on the following: physical and emotional comfort of the child and the caregiver as well as adjustability to account for a range of body dimensions and levels of trunk control. Efficacy was established through an A-B quasi-experimental design, with each child serving as their own control.

METHODS

Design of the Water Strider

The goal of the device was to provide trunk support that could be individualized for each child while they are suspended vertically in the water. This requires that the device be lightweight and buoyant, provide rigid support to the trunk, and be quickly adjustable for different sizes. The main components of the system included a Velcro-sensitive neoprene vest, horizontally adjustable padded trunk supports with industrial strength Velcro, and a polyvinyl chloride (PVC) outrigger with cylindrical polyethylene foam covers over the rigid frame (Figure 1). The device had to fit snuggly and securely to prevent the child from slipping or sliding through it when they were wet. Specific adaptations were required for children with deficits in head or upper thoracic control. A tray was used to prevent forward collapse into water, and a posterior support behind the head was used to facilitate active postural effort while also providing for stability of visual field with vertical head alignment. For the prototype, a rigid polyethylene foam support was secured to vertical PVC posts behind the child for head support (Figure 2A) or strapped horizontally to the outrigger in front of the child as a tray for those who required arm support

Fig. 1. Basic Water Strider prototype.

(Figure 2C). The floatation outrigger extended far enough laterally and anteroposteriorly to prevent the child from being able to tip the device. The trunk support mechanism was adjustable and could be locked into position with firm rigid grip on the child's torso while still allowing some flexibility for slight forward or backward lean for children who present with greater levels of trunk control.

Safety and comfort of the rigid trunk support were ensured in several ways. The Velcro-sensitive neoprene vest could be snuggly attached around the child's torso and had straps at the shoulders and between the legs to prevent it from sliding up or down. The padded trunk supports allowed firm pressure that could be distributed around the trunk without creating isolated pressure points. The adjustable portions of the frame that allowed custom fitting for each child could be locked in place so that the device remained firm around the torso as the child played in the water. One safety strap was buckled around the torso and another was placed under the child to prevent them from sliding down further into the water.

Quick adjustability was created by putting the neoprene vest on the child when dressing for the pool. Fitting the device to the child in the water required 2 adults, usually one researcher and assistance from the child's parent/guardian. The child was supported vertically, facing their parent or a researcher. The second adult expanded the device and brought it around the child from behind. The lateral pads were then compressed firmly to the child's torso, engaging the Velcro on the pads to the vest at the appropriate height. The device was then locked in place. Additional torso safety straps were attached with buckles, and the straps could be pulled tighter or loosened. To remove the child, the device was widened and the neoprene vest was removed from the child while they were held by their parent. Once the vest was released, the child could then be lifted out of the device, leaving the neoprene suit attached to the Water Strider.

Participants

Three children developing typically (aged 3, 5, and 10 years) were recruited by word of mouth for initial device fit and water trial to be sure the method was feasible and safe. Nine children with moderate-to-severe neuromotor disabilities (aged

Fig. 2. Baseline versus Water Strider trials. (A) Participant 5 baseline with parent support versus Water Strider with posterior head adaptation. (B) Participant 6 baseline with parent support and water wings versus Water Strider with no adaptations. (C) Participant 2 baseline with parent support and neck ring versus Water Strider with adaptations for head and arm support.

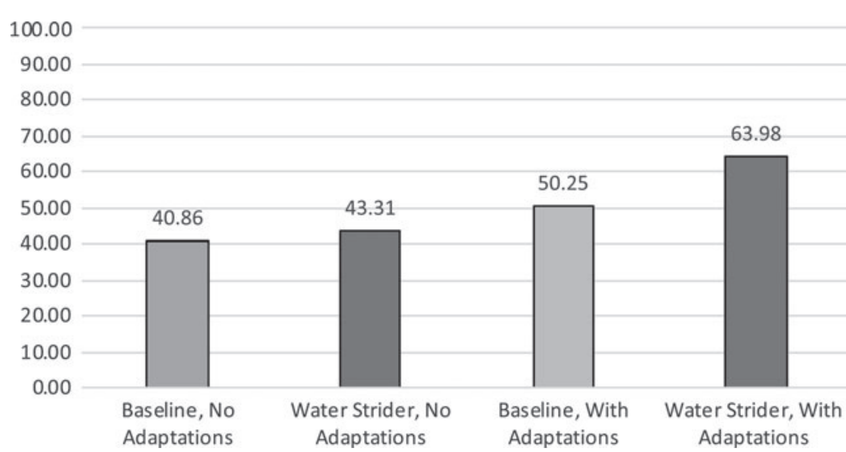

Fig. 3. Lower extremity movements—adaptations versus no adaptations.

2-8 years, mean age = 3.77 years) were recruited through a database of participants from previous studies conducted in the Pediatric Balance Lab at the University of Hartford and through word of mouth. Inclusion criteria for the feasibility study consisted of the following: (1) unable to sit erect with hands free for 3 minutes and (2) neuromotor diagnosis known to delay motor development. Exclusion criteria were related to aquatic safety (eg, no open skin wounds, tracheostomy, or illness). This study was approved by the Institutional Review Board at the University of Hartford. The procedures of the study were explained to parents during the first laboratory data collection, and informed consent was completed prior to initiation of data collection.

All participants completed 2 data collection sessions. The initial visit was performed at the University of Hartford and consisted of collecting descriptive data, including age, anthropometric data, history/background, 66-item Gross Motor Function Measure (GMFM-66),[14] GMFCS,[15] and Segmental Assessment of Trunk Control (SATCo).[16] To complete the SATCo, manual support is provided at 7 successive anatomical levels down the trunk. For each level of manual support, the subject is seated on a bench with straps secured to the legs and pelvis to create firm upright support for the pelvis. The clinician then progressively lowers the manual support while assessing the subject's ability to maintain vertical head and trunk alignment during quiet sitting (static control), during voluntary head turns or reaches (active control), and in response to brisk nudges (reactive control). The test is repeated until the subject is unable to control their body segments above the level of support. Outcomes for SATCo testing are reported as a *SATCo score*, as outlined by Argetsinger et al,[17] and *SATCo level* (lowest segmental level with full control).[16] Full control is defined as the presence of control in all 3 forms of testing (static, active, and reactive).[16] All participants ranged from "no control" to "mid-thoracic" levels of control on testing and were nonambulatory. All participants with a diagnosis of CP (n = 7) are classified as GMFCS level IV or V.

The subsequent visit was performed in the therapy pool at the Mandell JCC of the Greater Hartford area (water temperature = 27-30 °C/81-85 °F; pool depth = adjustable from 2-5 ft). The depth of the pool was selected to ensure the child's feet were not in contact with the bottom of the pool. Performing the session without lower extremity weight-bearing ensured the device could be used in both clinical and recreation settings considering the limited availability of a pool with a varying depth mechanism. An additional aquatic session was performed if further modifications were required for the Water Strider. One child completed a second aquatic session to allow additional device adjustments. Only the second session was used for her intervention data analysis.

Baseline measurements consisted of a 10-minute session, with the child performing their typical therapeutic activities in the pool. For this session, children were given parental or researcher assistance and devices that they typically used during aquatic activities. The Water Strider session consisted of an acclimation period (up to 5 minutes) during which modifications were determined and created. The 10-minute data collection session began when the child was safely fitted in the device and the parent(s) affirmed the child's comfort in the device. Researchers intervened during intervention trials for minor device adjustments. The order of the sessions was consistent for all participants to allow acclimation to the aquatic setting before introducing the Water Strider. A variety of activities were performed in both sessions to maintain the child's focus and enjoyment.

Video data were collected for all data sessions (above and below water for pool sessions). Baseline and Water Strider videos were behavior coded for upper and lower extremity movements, independence in the water, and number of "hazardous events" (water in eyes or water in mouth).

Outcome Measures

Primary outcomes for the study consisted of upper/lower extremity movements, assistance/independence in the water, and hazardous events. All outcomes were quantified as percent durations of the total 10-minute aquatic session. To avoid the effect that fatigue might have on the child's movement, coding included only the first 10 minutes in the device following the acclimation period. Most subjects were permitted to stay in the device up to 15 to 20 minutes. Secondary reliability coding was performed on 25% to 50% of video data for lower/upper extremity movements and assistance. Reliability scores, calculated as Cohen's kappa statistics (κ), were as follows: assistance = 0.78 (substantial agreement); lower extremity movements = 0.72 (substantial agreement); and upper extremity movements = 0.44 (moderate agreement). Reliability coding was not performed for hazardous events due to the low number of occurrences. Potentially hazardous events were reviewed and confirmed by all researchers prior to inclusion in the data analysis.

Extremity movements, defined as any voluntary movements of the arms or legs, were calculated separately for the upper and lower extremities. Types of lower extremity kicking patterns included reciprocal (alternating left and right legs), bilateral (synchronized lower extremity movements), unilateral right, and unilateral left. Upper extremity movement types consisted of bilateral, unilateral right, and unilateral left. Portions of data where the child's lower/upper extremities could not be seen were coded as "unable to be coded," and the total trial durations were adjusted on the basis of the duration of this code.

Assistance was coded in baseline and Water Strider sessions to determine autonomy/independence in the water. Any time where the child was able to be in the water without direct contact from a researcher or caregiver was considered *independence in water*. Subsets of assistance provided were safety, mobility, and adjustment (to the device fit).

Hazardous events consisted of water in the child's eyes or water in the child's mouth. Water in the child's mouth was identified by the child coughing or showing signs of discomfort through facial expressions after being splashed in the face.

Statistical Analysis

Statistical analysis consisted of calculating mean and SD values for all associated outcomes. Effect sizes were calculated using Cohen's *d*, and significance of results was determined using an analysis of variance ($P < .05$). Three-way analyses were performed to examine the relationships in the results for main effects and interactions between session, level of trunk control (*SATCo score*), and device adaptation (*yes* or *no*).

RESULTS

The study consisted of 9 children (male: 6; female: 3) with mean height = 101.5 cm and mean weight = 16.4 kg. See Table 1 for participant characteristics, device modifications, and activities performed in the water. The following conclusions were made on the basis of a comparison of video analysis from the 10-minute baseline session with analysis of the 10-minute session in the Water Strider. Results were expressed as increases/decreases from baseline video data resulting from implementation of the Water Strider. Outcome measures were calculated as mean values of percent duration for lower extremity movements, upper extremity movements, total assistance, and hazardous events across all participants.

Safety and Assistance

Most notably, mean total assistance required decreased from 100% at baseline activities to 21.0% in the Water Strider ($F_{1,8} = 384.4$, $P < .001$). Total assistance during baseline consisted of 100% assistance for safety; and percentages of total assistance in the Water Strider for safety, mobility, and adjustment were 0.74%, 10.2%, and 10.04%, respectively. Assistance for mobility in the device was given to avoid frustration of immobility in children who were not able to develop a motor pattern capable of successful device movement within the 10-minute device session. In addition, more hazardous events occurred in the baseline session (n = 15) than in the Water Strider session (n = 1). Analyses were not performed on hazardous events. No water-in-mouth events occurred while using the Water Strider, and one water-in-eyes incident occurred secondary to play. Twelve water-in-mouth events occurred in the baseline aquatic sessions. Use of the neck floatation device resulted in 67% of water-in-mouth events. Images of the neck floatation device being used during the present study can be found in Figure 2C.

Extremity Movements

Mean lower extremity movement durations based on various participant characteristics were evaluated to examine trends for extremity movements. Mean values were calculated for both baseline and Water Strider trials to examine tendency toward movement among participants with varying levels of trunk control. Participants presenting with no control (n = 2) or head control (n = 3) had slightly increased lower extremity movements (baseline: 60.92%; Water Strider: 64.13%) in contrast to participants with upper thoracic (n = 3) and mid-thoracic control (n = 1) who showed slightly decreased lower extremity movements (baseline: 35.61%; Water Strider: 32.84%). Participants requiring device modifications during the Water Strider trial (n = 5) were found to demonstrate significantly greater kicking durations across both baseline and Water Strider trials with a mean value of 57.12% compared with participants who did not require adaptations (n = 4) with a mean value of 42.08% ($F_{1,8} = 19.04$, $P < .001$). Additional nonsignificant changes from baseline to intervention across all participants include a 4.77% increase in lower extremity movements ($F_{1,8} = 0.008$, $P = .932$), a 2.80% increase in reciprocal kicking ($F_{1,8} = 0.052$, $P = .824$), and a 9.61% decrease in upper extremity movements ($F_{1,8} = 0.843$, $P = .377$).

Qualitative Observations

Varied responses to the Water Strider including relaxation (n = 3) and excitation (n = 2) were observed and commented on by parents and researchers, prompting an analysis of results at the individual level (Table 2). Individual results from each type of response are provided later as examples of general trends observed across participants. Participant 1 exhibited a *Relaxation* response, with a 4.60% reduction in lower extremity movements and 19.26% in upper extremity movements. Total assistance was 5.97% for this participant in the device compared with 100% at baseline. These participants demonstrated subjective improvements in postural alignment and secondary improvements in visual tracking on observation. Participant 6 demonstrated an *Excitation* response, with 25.98% increase in lower extremity movements and a 4.02% increase in upper extremity movements. Increased reciprocal kicking was exhibited for both participant 1 (1.71%) and participant 6 (22.48%).

TABLE 1
Participant Characteristics

ID	Age	SATCo	SATCo Level	GMFM	GMFCS	Baseline Activities	Water Strider Modifications
1	2	0	No control	16	V	Supported by the parent	Headrest, tray
2	2	0	No control	17	NA	Neck floatation device	Headrest, tray
3	5	2	Head	20	IV	Pool float, neck floatation device	Headrest, tray
4	6	3	Head	23	IV	Supported by the research assistant: vertical	Back support
5	7	3	Head	25	IV	Supported by the parent: vertical/supine/semiprone position	Headrest
6	2	6	Upper thoracic	28	IV	Supported by the parent: vertical/supine position	Water Strider
7	5	6	Upper thoracic	29	IV	Supported by the parent: vertical	Water Strider
8	2	6	Upper thoracic	62	NA	Supported by the parent: vertical/supine position	Headrest, tray
9	3	8	Mid-thoracic	21	V	Supported by the parent	Water Strider

Abbreviations: GMFCS, Gross Motor Function Classification System; GMFM, Gross Motor Function Measure; SATCo, Segmental Assessment of Trunk Control.

TABLE 2
Baseline Versus Water Strider Results

ID	SATCo	Lower Extremity (% Duration)[a]		Upper Extremity (% Duration)[a]	
		Baseline	Water Strider[b]	Baseline	Water Strider[b]
1	No control	66.7	59.7	42.2	32.08
2	No control	54.3	66.0	22.3	26.2
3	Head	60.5	76.4	30.1	21.7
4	Head	71.7	70.1	37.4	37.4
5	Head	59.7	80.4	40.4	14.3
6	Upper thoracic	10.8	35.5	45.1	44.5
7	Upper thoracic	57.4	51.1	43.0	28.4
8	Upper thoracic	38.2	39.3	58.6	49.9
9	Mid-thoracic	48.7	27.0	66.2	62.7
Summary		51.3	56.3	43.0	36.6
Effect size		0.22		0.49	

Abbreviation: SATCo, Segmental Assessment of Trunk Control.
[a]Sum of all coded movement types.
[b]Calculated on the basis of first 10 minutes following acclimation to the Water Strider.

Participants most commonly exhibited a mixed response (n = 4), with an increase in lower extremity movements and a minor decrease/no change in upper extremity movements.

DISCUSSION

The multisystem benefit in combination with a strong preference toward aquatic-based activities substantiates the need for viable aquatic therapies in nonambulatory children.[5-8] Limited access to physical therapy, unsafe aquatic activities, parent fatigue with water recreational activities, and limited aquatic facilities that are conducive for performance of ambulatory activities outlined in current research all serve as significant barriers for access to the therapeutic benefits of being in water.[9] These factors are further substantiated by a paucity of research that includes nonambulatory children.[8-11]

Safety and Assistance

Significant reductions in overall assistance and limited hazardous events (water in eyes or mouth) in the Water Strider confirm the efficacy of the proposed device in providing more severely impaired children with a viable mode of participation in aquatic activities while giving them autonomy of movement. The Water Strider could serve as a tool for aquatic therapy that can be performed in pools of variable depths, which includes static and dynamic balance for gait patterns.[6,7,9,11] Many of the hydrostatic and hydrodynamic benefits to body functions (vital capacity, range motion, tone relaxation, and decreased pain) would be achieved by simply providing access to a safe form of aquatic therapy.[12]

Instances of water in the child's mouth during baseline trials indicated a "user error" in regard to the parents' performance of their usual aquatic activities, which occurred most often with use of a neck floatation device. Unlike Roostaei et al,[10] no instances of water in the mouth during Water Strider trials indicate a safer form of aquatic activities. Parent education for device fitting could be completed following the initial device setup and would allow for use of the Water Strider in recreational settings.

Safe participation in aquatic activities with greater levels of autonomy has possible implications beyond the physiological benefits previously discussed. Providing children who lack trunk control in the appropriate postural contexts in the home or community allows them to communicate and interact with their environment.[18] Children with deficits in trunk control likely have decreased visual input, communication, and use of their extremities in various activity-based settings. Their success is closely linked to the amount of support they are provided, which occurs most often by various assistive devices or specialized seating and positioning systems. Children who lack head control can improve their upright ability with individualized external support at the correct level of the trunk.[16,18,19] Participation alone has demonstrated benefit on affect (anxiety and sense of inadequacy), motor function, and cognitive function (attention and hyperactivity).[20] Failing to provide children with access to forms of physical activity has similar implications on development of secondary impairments, including obesity, musculoskeletal deficits, and negative cardiovascular implications.[5,18]

Extremity Movements

Additional groupings based on trunk control and the presence of device adaptations versus no adaptations were created to examine trends in movement responses to the proposed device. Participants requiring the addition of a head support, arm support/tray, or both were considered "with adaptations" in compared with "no adaptations" when the device was fitted to the child and used successfully without added support. Mean values were examined on the basis of SATCo level, with groupings for participants with no control or head control (n = 5) versus participants with upper thoracic or mid-thoracic control (n = 4). Identical groupings of participants were found when creating groups based on levels of trunk control and adaptations versus no adaptations.

Although individual differences exist in upper/lower extremity movements in the Water Strider, findings that were significant are prone to type I errors due to small sample size. Nevertheless, these researchers propose 2 theories for observed differences in lower extremity movements between participants who required modifications and those who did not: (1) children who did not require modifications may have felt restricted by the device and unable to perform extremity movements; or (2) children who required modifications were more appropriately supported by the device than their baseline activities and more able to perform kicking movements. Similarly, there were differences between mean values for lower extremity movements between participants with more severe impairments (no control/head control or SATCo total = 0-3) and those with less severe impairments (upper/mid-thoracic control or SATCo total = 4-8). This may represent different responses to the Water Strider explained by the differing levels of movement and participation during the baseline trial. However, increases in lower extremity movements and reciprocal kicking pattern across all participants, although insignificant, could be attributed to the support the Water Strider provides and the ability to perform autonomous movements in the device. The onset of fatigue during the intervention trial and variable responses (excitation/relaxation) could have also contributed to nonsignificant findings.

Qualitative Observations

Qualitative observations were informally collected by 3 researchers secondary to differing responses while using the device. Despite mention of excitation and relaxation responses, both of these were viewed as positive from the parental perspective evidenced by praise for the function of the device. One participant's mother stated,

> When your child has a disability and can't use typical water toys, you can't just go to the store and find something that works. The Water Strider is incredible because it gives [my son] independence, which is something he doesn't have a lot of. He just lit up when he used it.

Subjective observations of improved participant/parent satisfaction, postural alignment, and participation serve as a supplement to improved safety and independence in the water. All participants were able to practice stable, upright head alignment with appropriate device modifications. The device served to provide children with independent environmental interactions and time to practice use of postural musculature.[21] This study is unique in its goal of demonstrating immediate effects of the proposed device in contrast to many other studies focused on demonstrating the effect of an aquatic intervention on various activity/impairment-level outcomes (GMFM, water orientation skills, 10-m Walk Test, Canadian Occupational Performance Measure, Pediatric Evaluation of Disability Inventory. Cerebral Palsy Quality of Life Questionnaire, Modified Ashworth Scale. According to Rosenbaum and Gorter,[21] observed improvements in body structure/function-level impairments in aquatic interventions have limited connections to functional outcomes/improved participation; and observed effects in available literature are likely fleeting without continued intervention. Further necessary, steps beyond proof of concept are needed to examine efficacy and safety of this type of device across time and setting.

Future studies featuring the Water Strider device could focus on demonstrating these effects on all levels of the ICF (International Classification of Functioning, Disability, and Health) model. Longitudinal studies including measures for quality of life, motivation, GMFM, SATCo, and attendance rate could provide valuable information on carryover effects of the proposed device. Additional outcomes focused on the use of the Water Strider device could strengthen its proposed efficacy. Quantifying subjectively observed effects on parent/researcher fatigue during trials and participant/parent satisfaction with the device could also be used in future studies. The use of a motivation scale and randomization of aquatic trials could help control for individual differences in extremity movements. Finally, educating parents on techniques for fitting their child in the device and evaluating longitudinal performance of this skill would help with further development of the current device.

CONCLUSION

In this study, the use of the Water Strider device increased safety and independence when compared to the individual baselines in the child's usual form of aquatic participation. Effect size calculations can be used to determine sample sizes for future longitudinal studies. Parent and child subjective responses to the device support the clinical relevance and utility of this type of device. Further development of this device is needed to determine parents' ability to don and doff the device as well as for use in longitudinal efficacy studies and studies in additional aquatic settings. Overall, this device has potential to improve therapeutic efficacy during aquatic interventions for children of GMFCS levels IV and V and nonambulatory children, as a whole.[9-11]

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