

Original Article

Adapted community-based group aquatic program for developing balance: a pilot intervention study involving children and adolescents with cerebral palsy

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Abstract:

Purpose: To assess the feasibility of a community-based adapted group aquatic program and its impact on balance in children and adolescents with cerebral palsy (CP). **Methods:** Thirteen children and adolescents participated in a 24-week community-based group aquatic program twice weekly for 45 minutes each session. The intervention included a combination of swimming and balance training exercises. The feasibility outcomes included measures of program acceptability and safety (e.g. recruitment, retention and attendance rates and program satisfaction), practicality (e.g. adult-to-child ratio) and efficacy (e.g. effect sizes). Balance was assessed with the Pediatric Balance Scale, the Timed Up and Go Test in Children, and the Timed Up and Down Stairs test. **Results:** All program acceptability, safety and practicality measures surpassed the feasibility thresholds. Parents/guardians and children reported high satisfaction with the program. No adverse effect was reported. All balance measures demonstrated a statistically significant ($p < 0.000$) improvement over the study period with mild to large effect sizes which were maintained over a two-month follow-up period. **Conclusion:** This aquatic program was feasible and showed potential for improving balance abilities in children and adolescents with CP.

Keywords: adapted aquatic exercises, swimming, feasibility, community-based intervention.

Introduction

The body balance is a fundamental prerequisite for adequate motor development of children (Westcott, & Burtner, 2004). While static balance is essential for the maintenance of body stability during stance, dynamic balance is crucial to all movements and to performance of most functional skills. (Westcott, & Burtner, 2004; Woollacott, & Shumway-Cook, 2005). The ability to maintain balance and posture is compromised in cerebral palsy (CP) due to primary deficits which result from non-progressive pre-, peri- or postnatal brain damage with subsequent neurologic and neuromuscular impairments (Shumway-Cook, Hutchinson, Kartin, Price, & Woollacott, 2003; Rose et al., 2002). Secondary musculoskeletal impairments also interfere with the development of body balance in CP (http://www.ncbi.nlm.nih.gov/pubmed/?term=Rose%20J%5BAuthor%5D&cauthor=true&cauthor_uid=11811652 Rose et al., 2002; Druzbicki, Rusek, Szczepanik, Dudek, & Snela, 2010).

The constraints on balance and posture cause varied impact on individual's level of physical activity and participation, on mobility at home, school and in the community, depending on the clinical form and severity of CP (Westcott, & Burtner, 2004; Druzbicki, et al., 2010; Gorter, & Currie, 2011). Even children with CP who are able to walk independently exhibit deficits in postural control, abnormal gait pattern and jeopardized gross motor skills (Woollacott, & Shumway-Cook, 2005; Rose et al., 2002). Thus, balance training is an important issue for children with CP and other neurological disorders.

It has been demonstrated that physical exercises can minimize balance and postural problems and physical exercise programs in water have some important advantages over land-based activities (Uzun, 2013; Mann, Kleinpaul, Mota, & Santos, 2014; Melzer, Elbar, Tsedek, & Oddsson, 2008; Roth, Miller, Richard, Ritenour, & Chapman, 2006). The unique physical properties of water which are beneficial for children with disabilities are well known and described elsewhere (Gorter & Currie, 2011; Getz, Hutzler, & Vermeer, 2006). In addition, aquatic activities are enjoyable and novel for children with CP, which helps them to enhance motivation, to improve social skills, self-confidence and to develop a life - long leisure skill (Jorgić et al., 2012).

Aquatic programs for balance training were mainly focused on healthy adults, elderly people, stroke survivors, patients with multiple sclerosis and other pathological conditions. Specific aquatic activities in these populations were designed to improve control of gravity center, postural stability and adjustments, sensory and sensory-motor integration, muscular tone among others goals (Vasile & Stănescu, 2013; Sarvestani, Tabrizi, Abbasi, & Rahmanpourmoghaddam, 2012). Some balance challenging aquatic exercise programs are based on the assumption that balance is a skill which can be trained with exercises which directly overload participants' postural control system (Melzer, Elbar, Tsedek, & Oddsson, 2008). For example, balance training protocol

described by Melzer et al. (2008) includes a combination of water-based perturbation tasks with balance reactions in response to changes in speed and direction of movements and base of support. Apart from balance training aquatic exercises swimming may also be beneficial for the development specific balance abilities in healthy populations and people with disabilities (Yilmaz, Yanarda, Birkan, & Bumin, 2004).

Only a few published studies were specifically designed to assess the impact of training programs on balance in children with CP. For example, Uzin (2013) reported the results of a long-term mixed (land-based and aquatic) individual program for children with CP which revealed a significant improvement in balance measures. The aquatic component in this program only included swimming for one hour once or twice per week. In other studies of aquatic interventions for children with CP balance training was not the major focus of the program but the results demonstrated some effects on balance related functions, i.e. the gross motor function, functional mobility, gait (Gorter, & Currie, 2011; Jorgić et al., 2012; Fragala-Pinkham, Haley, & O'Neil, 2008).

In most studies involving children with CP intervention programs were implemented individually (Uzun, 2013; Fragala-Pinkham et al., 2014; Dimitrijević et al. 2012; Retakar, et al., 2009). Such approach has some advantages as each child with CP has unique neurological condition and limitations of functional abilities. From this point of view, group training might be less adapted for such heterogeneous population as children with CP (Fragala-Pinkham et al., 2014). However, the benefits of group training are also well known. Group sessions allow simultaneous training of multiple participants. In addition, children and adolescents tend to select physical activities which can be performed with peers (Strong et al., 2005). The evidence suggests that group physical activities (including aquatic programs) promote social interaction, communication, interest and motivation to exercise (Kelly, & Legg, 2009). Group aquatic programs for children with disabilities can be implemented in different settings, i.e. rehabilitation centers and clinics, pediatric clinics, community sports and recreation facilities. The later facilities might be particularly important for children with limited functional mobility, due to their accessibility. However, only a few studies have reported effectiveness of community-based adapted aquatic programs for balance training in people with disabilities but none of them was focused on children and adolescents with CP.

Considering the fundamental role of balance function in functional mobility, physical activity and participation, the potential benefits of group aquatic activities and also the scarcity of published studies on group aquatic interventions for balance, the goal of the present study was to evaluate the feasibility of a community-based adapted group aquatic program for children and adolescent with CP and its impact on balance measures.

Methods

The study received an approval from the Research Ethics Committee of the Lobachevsky University and was conducted according to the ethical principles for research involving human beings of the World Medical Association's Declaration of Helsinki as revised in 2000. All children and their parents/legal guardians agreed to the participation by signing a statement of free and informed consent before taking part in the study. The participants were allowed to withdraw from the study any time without providing any reason.

The participants were recruited using a convenience sampling method. Children and adolescents were eligible for the program if they were 5 to 17 years of age, had the diagnosis of CP, were able to understand simple instructions, were available for aquatic intervention program twice per week for six months and had no medical contradictions for swimming and exercises in water. Exclusion criteria were: surgical intervention, casting or botuline toxin treatment in the preceding 6 months; anticipated changes in regular treatment or rehabilitation during the study period; participation in any other physical exercise program that affect balance. All the participants received their usual medication and physical therapy care during the intervention.

Interventions

The intervention took place at a community sports center which has two indoor swimming pools: rectangular 25 x 12 m pool (water temperature 26.5-27.5°C, water depth 100 cm to 190 cm) and free shape pool (water temperature 29-31°C, water depth 50 cm to 90 cm, water surface area 181 m²). The aquatic program lasted 6 months, at a frequency of 2 sessions a week with the integral duration of each session of 45 minutes. All sessions were led by two certified adapted physical activity (APA) instructors with practical assistance from trained volunteers and parents/guardians. The overall supervision of the program was provided by the APA University faculty and pediatric physical therapists.

Typically, each training session consisted of three phases: a warming up (10 min), main training phase (25-30 min) and a cool down phase (5-10 min). Floating devices were allowed to use if it was necessary. The warming up phase was conducted in the shallow side of the pools. The participants performed exercises for adaptation with aquatic environment, static stretching for the extremities, walking in the water. In the main phase the children worked on swimming techniques and performed selected activities for balance training according to the individual goals. The cool down phase consisted of stretching, low intensity recreational and relaxation activities (e.g. freestyle swimming, floating while relaxing, deep breathing, etc.).

The aquatic activities for balance training were based on the Functional and Specific Balance Training Program (FSBTP) and were conducted according to the principles of this program, i.e. specificity, progressive overload and individualization (Melzer et al., 2008). The water-based exercises were grouped in five levels with

increasing demands on the balance control system: levels 1-4 consisted of aquatic tasks that were focused on the skills to maintain balance (e.g. standing exercises with and without external support, gait exercises with dynamic base of support), whereas level 5 included perturbation tasks for training reactive and proactive balance reactions (Melzer et al., 2008). The specific balance training content gradually increased over the time course of the program. During the initial phase of the program the main focus was on adaptation to the aquatic environments and learning of water safety and basic swimming techniques. Later on, more attention was given to the balance training activities and teaching of advanced swimming techniques.

Several program adaptations were used to address the unique needs and to consider the functional status of each child. All adapted aquatic activities were individualized according to the child's age, general condition, mobility level, coordination and balance capacity and swimming abilities. The APA instructors and volunteers provided verbal instructions combined with demonstrations and physical guidance for the children. The aquatic exercises were simplified as needed so the children were able to succeed in the activities. The parents and guardians actively participated in the training sessions, helped to customize the aquatic activities to maximize enjoyment of each child. To address the differences in functional abilities, training intensity varied from child to child. The exercises routine for each participant was gradually developed and the aquatic activities were progressively consolidated, according to the child's progress in learning of movements and swimming skills. Although the sessions were individualized, all participants experienced similar aquatic activities.

Outcome measures

Feasibility outcomes were organized into the following categories: acceptability, practicality, safety and efficacy (Bowen et al., 2009). Outcome measures, criteria for success and results of acceptability, practicality and safety of the program are shown in table 1. Criteria for success were adopted from the previous studies (Ballaz et al., 2011; Bowen et al., 2009; Simpson, Eng, & Chan, 2016).

Table 1. Characteristics of acceptability, practicality and safety of the program

Indicator	Outcomes	Criteria for success	Results
Acceptability			
Recruitment rate	% of participants approached who were eligible and agreed to participate	30%	55.2%
Retention rate	% of participants completed the program	>80%	81.3%
Attendance rate	% of attended sessions in the whole group	>80%	81.7%
	Minimal attendance rate	>65%	70.8
Program satisfaction	Program satisfaction questionnaires for children and parents/guardians	No negative responses	No negative responses
Practicality	Adult-to-child ratio for training sessions	One-to-one	One-to-one
Safety	Number of reported accidents, injuries or adverse effects	None	None

Satisfaction of the children and parents/guardians with the program was measured with two questionnaires (Fragala-Pinkham, Haley, & O'Neil, 2011). The parent/guardian's questionnaire includes items on overall satisfaction with the program activities, program instructors and volunteers, facility, location of the program, child's accomplishments and fitness testing procedure. The responses were given on a five-point scale from minus 2 (very dissatisfied) to plus 2 (very satisfied). The child's version of the questionnaire consisted of items on overall program satisfaction, willingness to continue with the program and satisfaction with the progress in swimming abilities. The responses were rated on a five-point scale or a two-point scale.

Efficacy of the program was assessed using three balance and mobility measures (primary outcomes): the Pediatric Balance Scale (PBS), the Timed Up and Go Test in Children (TUG-IC), and the Timed Up and Down Stairs test (TUDS). In addition, swimming skills of children were also assessed (secondary outcome).

The PBS consists of 14 tasks representing various activities of daily living (Franjoine, Gunther, & Taylor, 2003). Each item is scored on a five-point scale from zero (inability to perform the activity) to four (ability of perform the task independently). The maximal score is 56 points. The TUG-IC requires a child to rise from a seat, stand up, walk 3 meters towards a wall, touch a wall, turn, return to the seat, and sit down (Williams, Carroll, & Reddihough, 2005). The results were expressed in seconds. The TUDS was selected as an outcome measure because it assesses the ability to negotiate stairs – an important activity of daily leaving which is not tested in the PBS and TUG-IC. The TUDS involves a child ascending one flight of stairs, turning around, and descending to the starting point (Zaino, Marchese, & Westcott, 2004). The test was scored in seconds.

Swimming skills of the participants were assessed with the Swimming Classification Scale (SCS) which has five levels of swimming abilities ranging from level 1 (unable to swim) to level 5 (able to swim without a floatation device) (Fragala-Pinkham et al., 2008; Fragala-Pinkham, Haley, & O'Neil, 2011). Previous studies have demonstrated that the scale was responsive to progress in swimming abilities in children with CP (Fragala-Pinkham, et al., 2011; Fragala-Pinkham, O'Neil, & Haley, 2010).

The English versions of the scales and questionnaires were translated into Russian and were checked through blind back translation. The Russian versions of the program satisfaction questionnaires were reviewed for clarity and comprehension by a focus group. All the items were found clear and culturally appropriate.

The balance measures were taken three times as well as the assessment of swimming skills: at the baseline, at the end of the intervention and in two month time after cessation of the intervention (follow-up data). Each participant was tested individually by a trained APA instructor who was not aware of the study design and previous test data. The program satisfaction was assessed at the end of the intervention.

Data analysis

The statistical analysis was performed with the help of SPSS statistics software version 20. The Shapiro-Wilk test was used to challenge the assumption of normal distribution of the group data and found no sufficient evidence to reject the null hypothesis that the data are normal. Therefore, parametric paired Student's t-test was used for analysis of group data changes over time. Effect sizes for each of the balance measures were calculated and interpreted in accordance with the Cohen's guidelines: values of Cohen's d equal and above 0.2 – small effect size, 0.5 – moderate and 0.8 and above – large (Portney, & Watkins, 2000). Chi-square test was employed for the assessment of differences in distribution of the participants across the SCS levels. Statistical significance was set at a threshold value of 0.05.

Results

Acceptability, practicality and safety of the program

Data in table 1 demonstrate that all acceptability, practicality and safety outcomes surpassed the feasibility thresholds. A total of 29 individuals were approached to participate in the program, 21 of them were interested to participate but only 16 children and adolescents met the inclusion criteria. Three participants withdrew from the study for reasons such as inability to attend practice sessions, health problems or changes in the therapy or rehabilitation program. Thus, 13 participants (7 males and 6 females) completed the program and composed the final sample. All of them were available for follow-up assessments. Mean age of the group was 9.6 years (SD=4.7) with age range from 5 to 17 years. Most of the participants (11 out of 13) had the spastic clinical form of CP and two – the ataxic form. Two children had level I on the Gross Motor Function Classification System - Expanded and Revised (GMFCS-ER), five – level II, and 6 – level III. The GMFCS-ER assesses present abilities of children with CP in gross motor function using a five-level classification system from level 1 – walking without restriction to level 5 – severe limitation of self-mobility (Palisano et al., 1997).

There was no need in employing additional instructors for the program. Seven volunteers (university APA students) were recruited and trained to provide assistance to the children during aquatic sessions. Parents or guardians also participated in the sessions. Thus, one-to-one adult-to-child ratio was achieved.

On the program satisfaction questionnaire all the participants reported high levels of overall satisfaction with the aquatic program and willingness to continue with the training sessions. The participants also noted that the program helped them to learn or to improve swimming skills. Satisfaction of the parents/guardians with the aquatic program was also high (table 2). It is worth to note that there were no negative responses on all items of the program satisfaction questionnaire.

Table 2. Results of the analysis of program satisfaction questionnaire responses: parents/guardians version.

Items	Responses				
	+2	+1	0	-1	-2
The aquatic program	10	3	0	0	0
The program instructors and volunteers	10	3	0	0	0
The facility	10	3	0	0	0
The location of the program	8	5	0	0	0
Child's accomplishments	13	0	0	0	0
The fitness testing procedures	10	3	0	0	0

Note. Figures represent number of responses according to the response category: +2 – very satisfied, +1 – satisfied, 0 – neutral, -1 – dissatisfied, -2 – very dissatisfied).

Efficacy of the program

Table 3 presents the data on balance measures in the study group. All participants, regardless of age, gender and severity of mobility limitation, demonstrated improvements in the analyzed parameters over time. In the whole group of participants the mean PBS score significantly increased after the aquatic intervention with a large effect size between the pre- and post test values. The two-month follow-up mean PBS group value decreased compare to the post-test value but remained higher than at the baseline. The mean group time of the TUG-IC test significantly decreased (i.e. improved) after the intervention program. During the follow-up period the mean group value increased compare to the post-test value but remained lower than the baseline group mean. The mean group value of the TUDS test significantly decreased (improved) during the study period. In two-

month time after cessation of the aquatic program the mean group TUDS test value was still lower than at the baseline but higher than at the end of the program.

Table 3. Results of the Timed Up and Go – In Children (TUG-IC) test, the Timed Up and Down Test (TUDS) test and Pediatric Balance Scale (PBS) scores in the study group.

Test	Mean values (SD)			Statistical significance and Cohen's <i>d</i>		
	Baseline	Post-test	Follow-up	Post-test to baseline	Follow-up to baseline	Follow-up to post-test
PBS, score	24.4 (15.1)	36.8 (14.1)	34.0 (14.4)	t=8.303, p=0.000, d = -0.846	t=6.723, p=0.000, d = -0.652	t=4.693, p=0.000, d = 0.194
			17.5 (10.0)	t=6.675, p=0.000, d = 0.850	t=5.726, p=0.000, d = 0.789	t=5.283, p=0.000, d = 0.440
TUG-IC, sec	23.5 (12.2)	16.0 (9.7)	85.5 (64.1)	t=5.090, p=0.000, d = -0.383	t=5.376, p=0.000, d = -0.336	t=2.670, p=0.020, d = -0.046
TUDS, sec	108.6 (72.9)	82.6 (62.1)				

Distribution of the participants according to the SCS levels is shown in table 4. At the beginning of the study more than half of the participants (7 out of 13) did not have swimming skills (level 1), 4 children were only able to swim with floating devices (levels 2 and 3), 2 children were able to swim without a floating device (level 4) and none had advanced swimming skills (level 5). Chi-square test demonstrated a significant difference between the baseline and post-test distributions across the SCS levels ($\chi^2=13.0$, $p=0.011$) with a shift towards higher levels which suggests an improvement in swimming abilities in the group during the study period. Within-group difference between the post-test and follow-up distributions was not significant ($\chi^2=1.2$, $p=0.878$). All the children but one retained their swimming level two months after the cessation of the program.

Table 4. Distribution of the study participants across Swimming Classification Scale levels.

Swimming level	Baseline	Post-test	Follow-up
1	7	0	1
2	1	3	2
3	3	3	3
4	2	2	2
5	0	5	5

Discussion

The aim of the present study was to evaluate the feasibility of an adapted community-based group aquatic intervention program for children and adolescents with CP. The program seems to be feasible for several reasons. First, the results of the study demonstrated high acceptability and safety of the aquatic program for its recipients. This is confirmed by high recruitment, retention and attendance rates which surpassed the feasibility thresholds. Program satisfaction of the children and parents/guardians was also high according to the responses on the program satisfaction questionnaires. The program was safe as no accidents, injuries or adverse effects were reported during the entire training period. Second, the program was practical and cost effective as it utilized existing facilities of a community sports center. The group aquatic sessions were easy to integrate within the existing system of training and recreational activities of the center. There was no need in recruiting additional staff apart from volunteers. However, close supervision of the program by APA faculty, medical doctors and physical therapy staff was necessary to ensure its safety, flexibility and individualization. Apart from the APA instructors and volunteers, parents/legal guardians also participated in implementation of the program activities which allowed achieving high adult-to-child ratio for every session and helped to create enjoyable, motivating and safe environment for the children. The group sessions with one-to-one adult-to-child ratio allowed combining the benefits of group training with individual approach to each child. For these reasons practicality and sustainability of the program, its potential for expansion and adaptation to a different population look very high. Third, the significant improvements in balance in the study group, as measured by the PBS, TUG-IC and TUDS tests, also confirm the program feasibility. The positive changes in balance measures were observed in all participants. In addition, the program has favorable impact on swimming abilities of the participants as all of them demonstrated improvements in swimming skills by 1-2 SCS levels.

The improvements in balance measures would be important if they constitute clinically meaningful changes which may be assessed and quantified through the measures of effectiveness of intervention (i.e. effect size). In the present study, the effect size of the baseline to post-test difference for the mean PBS score and for the TUG-IC were large and for the TUDS – small. Such difference in the effect sizes between outcomes may be

explained by the differences in complexity of the three balance measures. The TUDS test is more challenging than the PBS and TUG-IC as stair negotiation (TUDS) is a more advanced activity and a more challenging task than level walking as it requires greater strength of skeletal muscles and range of joints motion and higher ability to coordinate movements and to maintain balance (Nightingale, Pourkazemi, & Hiller, 2014).

Effectiveness of the aquatic program in the present study was also confirmed by sustainability of the effects after the intervention. The aquatic skills of the participants demonstrated the highest level of sustainability. Regarding the balance measures, all mean group values showed a statistically significant decline over a two-month follow-up period with a trivial difference according to the effect size values for the PBS and TUDS and a small effect size for the TUG-IC. However, compared to the baseline mean group values, the effects of the aquatic exercise program were maintained with moderate to small effect sizes. These findings concur with the results of other studies which also showed that the effects of aquatic interventions maintained at the follow-up periods of various durations (Getz et al., 2006; Fragala-Pinkham et al., 2008) but swimming skills are more sustainable than other outcomes of aquatic programs (Dimitrijević et al., 2012).

The impact of the present aquatic intervention on balance measures in children with CP may be attributed to a combination of factors. First, individualized group sessions allowed combining the advantages of individual approach to each participant with the benefits of group environment. Second, the program was long enough to gradually build up swimming skills and balance abilities of the participants. Third, the program was adapted to the unique needs and abilities of children with CP. Fourth, the specific content of the training sessions was composed of a combination of swimming and water-based balance challenging tasks of the FSBTP.

Due to the scarcity of published research on feasibility and effectiveness of group aquatic interventions in children with CP the comparison of findings of the present investigation with other studies is limited. Fragala-Pinkham et al. (2008) have studied effectiveness and safety of a 14-week community-based group aerobic aquatic exercise program in a heterogeneous group of children with autism spectrum disorder, CP and other developmental disabilities. The results revealed effectiveness of this program in improving cardiorespiratory endurance, but no significant improvement in muscle strength or motor skills was documented. Another study has demonstrated feasibility of a group swimming program in adolescents with CP and its effectiveness in improving gait efficiency (Ballaz et al., 2011). The study of Fragala-Pinkham et al. (2011) has demonstrated effectiveness of a community aquatic program in improving swimming abilities but not in fitness outcomes of children with autism spectrum disorders. This program was conducted with one-to-two child-to-adult ratio.

The important question on the results of any aquatic intervention is whether the improvements of body functions in water cause functional gains in the gravity dependent environment (i.e. land). In the present study all measurements were done on land. The results demonstrated a significant improvement in balance function in land-based activities as measured by the PBS, TUDS, and TUG-IC tests after the aquatic intervention. Therefore, we can speculate that a water-based program may be beneficial for balance function on land in the study group. This concurs with a study of Roth et al. (2006) which concluded that in healthy young adults the progression from water-based to land-based balance training may not be necessary for functional gains on land. However, the extend of carry-over effects from the aquatic to dry-land environment needs further investigation.

Limitations

The study has several limitations. Due to the study design and sampling limitations it was not feasible to recruit another group of participants who meet all the inclusion criteria and match closely with the intervention group. This is a common limitation of most of reported aquatic intervention studies which involve children and adolescents with special needs (Gorter, & Currie, 2011; Getz et al., 2006; Karklina, Declerck, & Daly, 2013). The sample size in the present study was rather small. However, the size of the study sample was appropriate for group aquatic sessions for children with special needs.

Heterogeneity of the intervention group in the present study is both a strength and a limitation. The limitation is that interpretation and generalization of the results require some caution. The strength is that the improvements in balance measures after the program appeared to be present in all children and adolescents regardless of clinical diagnosis, gross motor function level, age or gender. In addition, according to the principles of inclusive physical education, it is a current trend and a common practice for community sports centers to conduct training sessions in heterogeneous groups of children and adolescents. The present pilot study demonstrated some encouraging preliminary evidence that group aquatic interventions might be beneficial for all participants. This needs to be replicated with a larger sample and a control group.

In the reported studies on aquatic interventions for children and adolescents with CP the overall duration of the programs ranged from 5 to 36 weeks, 1-3 times per week with usual duration of each session 30-60 min (Gorter, & Currie, 2011; Jorgić et al., 2012). It appears that the programs with longer durations are more beneficial for children than short-term interventions as they allow enough time to achieve sustainable effects (Fragala-Pinkham et al., 2008; Retakar et al., 2009; Ballaz et al., 2011). The duration of the present pilot aquatic program was 6 months, two 45-minute sessions a week. The selection of the overall duration of the intervention program was based on the fact that most of the participants in the present study had poor swimming skills. Therefore, the aquatic program had to include the initial phase to teach children the basic aquatic and water safety skills as well as to gradually implement the balance challenging activities according to the FSBTP levels. In addition, a 24-week study period was realistic as it was not interrupted by the major public holidays and

vocations (e.g. Christmas and summer vacations). Two aquatic sessions a week on nonconsecutive days allowed children and adolescents to have the sufficient training time and adequate recovery time between the sessions.

As in many other aquatic intervention programs for children with special needs, training intensity was not objectively controlled in the present study. First, there is still lack of practical and reliable tools to measure the exercise intensity in an aquatic environment in this population (Karklina et al., 2013). Second, as the training sessions were individualized, the training intensity varied from child to child. However, from the observational analysis during training sessions the exercise intensity was rather low.

Conclusions

This pilot study demonstrated the feasibility of a community-based adapted aquatic program involving a heterogeneous group of children and adolescents with CP and mild to moderate limitations of gross motor function. The group aquatic sessions which were conducted with a high adult-to-child ratio allowed combining the benefits of a group environment with the individualized approach to each participant. The training sessions which incorporated swimming and balance challenging tasks of the FSBTP had a positive and sustainable impact on balance measures of the participants. The program might be considered to augment the rehabilitation process to improve balance function of children and adolescents with CP.

The results of the present pilot aquatic intervention program for children and adolescents with CP support further research in this area which is required to examine the feasibility and benefits of community-based aquatic training programs with different populations of children and adolescents with special needs. In this respect, further research on the ways of overcoming the barriers for participation in aquatic intervention programs would be beneficial (Gorter, & Currie, 2011). In addition, research regarding the sustainability of postintervention effects over longer periods is also required.

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